The British Veterinary Journal

DECEMBER, 1958

CONTENTS

(The Whole of the Literary matter in The British Veterinary Journal is Copyright)

PAGE

Editorial

Thoughts on the end of a year 453

General Articles

Observations on some Aspects of the Corticosteroids in Small Animals

H. GLOVER, M.R.C.V.S. 456

Studies on Intervertebral Disc Protrusion in the Dog

L. C. VAUGHAN, F.R.C.V.S. 458

Observations on the Distribution of Birefringent Crystals in the Adrenal Gland of the Sheep

W. M. STOKOE, B.Sc., M.R.C.V.S. 463

The Control of Nematodirus Infestation by Preventive Treatment

W. J. M. BLACK, B.Sc. (Agric.), R. J. THOMAS, Ph.D., M.Sc., B.V.Sc., M.R.C.V.S., and J. GREASLEY, B.V.Sc., M.R.C.V.S. 470

Pulmonary Tuberculosis in a Cow due to the Avian Type of Tubercle Bacillus

J. K. L. PEARSON, Ph.D., B.Sc., M.R.C.V.S., and D. MCGOWAN, M.R.C.V.S. 477

Studies on Metabolism of Creatine and Creatinine in the Dog

M. G. E. MOUSTAFA EL HEHYAWI, B.V.Sc., M.V.Sc. (Cairo), Ph.D. (London). 480

Correspondence 484

Reviews 484

Notices 486

NOTICE TO CONTRIBUTORS

Please turn to the inside back cover of this **Journal** *for particulars regarding submission of articles to the Editors.*

FOUR IMPORTANT BOOKS

DISEASES OF CATTLE

Edited by Finaher, Gibbons, Mayer and Park

Twenty-five chapters covering Physical Examination, Laboratory Examination, Administration of Medicines, Nutrition, Diseases of Calves, The Respiratory System, The Circulatory System, The Digestive System, The Urogenital System, The Blood and Blood-Forming Organs, The Locomotor System, The Skin, Artificial Insemination, Diseases Due to Physical Agent, Toxicology, Bacterial Diseases, Leptospirosis, Viral Diseases, Protazoan Diseases, Diseases of Metabolism, Miscellaneous and Unclassified Diseases, Salvage Through Slaughter and Herd Management.

57 AUTHORS - 762 PAGES - 234 ILLUSTRATIONS - PRICE128s.

CANINE SURGERY

New Revised Fourth Edition

Thirty-one chapters completely revised. Anatomy, Physiology, Healing and Repair, Surgical Principles, Sterile Technic, Sutures and Ligature, Approach and Restraint, Anæsthesia, Pre-surgical care, Wound protection, Physiological Consideration of Some Postoperative Conditions, The Skin, Dental Surgery, The Mouth, The Tonsils, The Larynx and Trachea, Sublingual and Submaxillary Salivary Cyst, The Nose, The Ears, Eyes and Eyelids, The Thyroid Gland, The Neck, The Thorax, The Abdomen, The Genito-urinary System, The Mammary Glands, The Anus and Rectum, The Legs, Fractures, Luxations, and Cosmetic Surgery.

30 AUTHORS - 816 PAGES - 600 ILLUSTRATIONS - PRICE 144s.

PATHOLOGY

OF THE DOG AND CAT

(GENITO-URINARY SYSTEM)

by Frank Bloom, D.V.M.

A valuable book for the clinician who knows that the tendency to transfer conclusions based upon valid human genito-urinary pathology to the dog and cat has resulted in errors both in diagnosis and treatment. Out of his twenty-five years of experience in practice and teaching, Dr. Bloom writes with authority. The genito-urinary organs are described on a systematic basis. For each organ the normal, gross and microscopic anatomy is described and then compared to the pathological under the headings of: Congenital Anomalies; Circulatory Disturbances; Trauma; Regressive Changes; Inflammations; Primary and Secondary Tumors and Parasites. A comprehensive discussion of the canine prostate is included.

480 PAGES - 312 ILLUSTRATIONS - PRICE 96s.

CANINE MEDICINE

New Revised Second Edition ***Ready October***

Twenty-eight chapters embracing Clinical Examinations, The Administrations of Medicines, Nutrition, The Digestive System, The Respiratory System, The Urogenital System, The Blood and Blood-Forming Organs, The Heart, The Endocrine Gland, The Anatomy of the Skin, The Skin, The Locomotor System, The Ear, The Eye, The Nervous System, The Allergies, Metazoan Infections, Mycotic Diseases, Rickettsial, Spirochetal, Bacterial and Viral Diseases, Diseases Caused by Physical and Toxic Agents, Gerontology, Pediatrics, Euthanasia, Parenteral Fluid Therapy, and Inhalation Therapy.

The contents of this edition, will be more than 60% all new.

52 AUTHORS - 724 PAGES - 261 ILLUSTRATIONS - PRICE 144s.

PUBLISHED BY AMERICAN VETERINARY PUBLICATIONS INC., SANTA BARBARA, CALIF. U.S.A.

OBTAINABLE FROM

Baillière, Tindall & Cox, 7 & 8 Henrietta St., London W.C.2

THE BRITISH VETERINARY JOURNAL

EDITORS :

J. McCUNN, *F.R.C.S., L.R.C.P., M.R.C.V.S.*

R. LOVELL, *D.Sc., Ph.D., M.R.C.V.S., D.V.S.M.*

SIR THOMAS DALLING, *M.A., D.Sc., F.R.C.V.S., F.R.S.E.*

Vol. 114 **December, 1958** **No. 12**

The whole of the matter appearing in "The British Veterinary Journal" is Copyright and may not be reproduced in whole or in part without permission.

EDITORIAL

THOUGHTS ON THE END OF A YEAR

The span of a man's life may cover many years and yet it is but a dot in the infinity of time. From birth to death he is never free from perils which may disturb or foil the even tenor of his way. The hazards can be of an intimate personal nature and manifested in ill health of mind or body, they may stem from circumstances associated with his environment, be engendered by family or economic factors, or it may be that the victim is one on whom Fortuna has not deigned to smile. The journey through life can be likened to a point-to-point race. It calls for great stamina, pluck and endurance, for there are many obstacles on the course and the manner in which these are approached and surmounted serves as a measure which betokens ultimate success or failure.

A year is a unit in the successive state of time; each has a beginning, then surges to maturity and having blossomed dies. As the years pass by in panoramic sequence and each one comes to its destined end, it is well to tarry awhile, and enquire how one has fared in the race so far. Are we satisfied with the progress which has been made, have we taken advantage of all the opportunities which have been displayed, have we added to the sum of knowledge and have we made any contribution to the welfare of mankind? He who can make answer in the affirmative is a happy man indeed even if his assessment be born of error. A critical appraisement of the records of the past can be of the utmost value not only in the assessment of one's present state but as a guide to future action. What better time can there be for this interrogation than at the close of the year?

In world affairs 1958 has not been dissimilar to its immediate predecessors and discord amongst the nations still holds sway. Fortunately there has not been a major clash of arms, the altercations have been conducted in a battle of words. As long as the antagonists are content to talk, argue and hurl abuse into the air, no matter how vituperative are the words they use, the anxious world can take another breath and rest in a modicum of peace.

In the field of veterinary endeavour the profession has experienced another year of full employment and prosperity. In spite of the continued increase in the number of new graduates there are still more jobs available than there are the men to fill them. Young graduates can " play the market " to their own financial satisfaction and

much of the published work and several papers are quoted. Perhaps it would have been more helpful and in keeping with a monograph of the calibre of this one, had published work been assessed more critically and where antibiotic drugs had obviously been exhibited, either too late or in inadequate dosage, for the results to have been ignored. Had this been done it is felt that more helpful guidance on the lines of penicillin being recommended in heroic doses early in the disease might have emerged. Certainly there is good theoretical evidence for the efficacy and harmlessness of this drug and it has in practice, been attended by favourable experiences. This monograph confirms that there is no evidence that the more recently discovered and more costly antibiotics possess any advantage over penicillin. Serum therapy is discussed in a non-committal manner but without mention of the very real dangers of the various manifestations of serum sickness at least, in man.

In the main the illustrations are helpful but whereas this feature tends to add materially to the cost of publication as well as the bulk of the tome it is felt that some of those depicting various occupations in which Leptospirosis is a recognised hazard are not particularly edifying and could with advantage be omitted in future editions.

Finally, the inclusion of a chapter on the legal aspect of Leptospirosis by a distinguished Queen's Council is inspired. In these days of free legal aid and a litigious laity it is becoming more and more necessary for both veterinary and medical practitioners to be cognisant of the salient features of the legal position as applied to themselves, their patients and to the institutions which they serve. A signal service therefore has been done in devoting a full chapter to this important aspect of a disease which may be contracted with comparative facility either at work or at play. It is hoped that the practise of inviting the co-operation of members of the legal profession in publications intended for undergraduates and practitioners will become more general.

While it is easy to pick out trivial faults in most publications it is, in general, an unhelpful activity and in any event in this monograph there are gratifyingly few. In general it is a book printed well, elegantly produced and of reasonable price. It will commend itself to the intelligent medical practitioner; to the veterinary surgeon it is essential and the excellent bibliography and indices render it indispensible to the research worker in this field.

GENITAL VIBRIOSIS IN THE BOVINE, by H. C. Adler. Copenhagen 1957 A/S Carl F. Mortensen.

THIS thesis accompanied by an adequate bibliography was prepared on the basis of experiments made from 1952 to 1955, whilst the author was at the Royal Veterinary and Agricultural College, Copenhagen.

He describes his technique for the cultivation of *Vibrio foetus* from the cervical canal of heifers and concludes that it is possible to demonstrate the organism as early as two days after infection although the greatest chance of success is at about two weeks. Bulls which carry *V. foetus* may be detected by serving heifers and experimental heifers which are not infected may be used repeatedly. The incidence of infection appears to be greater in old bulls and the addition of streptomycin to infected bull semen is considered to be effective in most cases against the spread of infection by insemination. Streptomycin is also effective in heifers within 24 hours of infection; 1g. of this antibiotic is considered a suitable dose when applied to the genital tract, although in infected females, treatment should be undertaken for three days or twice at an interval of 48 hours. Treatment of infected bulls appears to be less certain in its effect; although *V. foetus* may not be demonstrable for long periods it is not always certain that permanent cure has been effected.

The control of Vibrio infection in cattle in Denmark consists of the cleansing of bull centres of infection and thereafter to determine their continued freedom from infection. Semen for artificial insemination should be treated with streptomycin and in cattle herds in which the disease is detected the animals returning to service should be treated.

XUM

The British Veterinary Journal

DECEMBER, 1958

CONTENTS

(The Whole of the Literary matter in The British Veterinary Journal is Copyright)

PAGE

Editorial

Thoughts on the end of a year 453

General Articles

Observations on some Aspects of the Corticosteroids in Small Animals
H. GLOVER, M.R.C.V.S. 456

Studies on Intervertebral Disc Protrusion in the Dog
L. C. VAUGHAN, F.R.C.V.S. 458

Observations on the Distribution of Birefringent Crystals in the Adrenal Gland of the Sheep
W. M. STOKOE, B.Sc., M.R.C.V.S. 463

The Control of Nematodirus Infestation by Preventive Treatment
W. J. M. BLACK, B.Sc. (Agric.), R. J. THOMAS, Ph.D., M.Sc., B.V.Sc., M.R.C.V.S., and J. GREASLEY, B.V.Sc., M.R.C.V.S. 470

Pulmonary Tuberculosis in a Cow due to the Avian Type of Tubercle Bacillus
J. K. L. PEARSON, Ph.D., B.Sc., M.R.C.V.S., and D. MCGOWAN, M.R.C.V.S. 477

Studies on Metabolism of Creatine and Creatinine in the Dog
M. G. E. MOUSTAFA EL HEHYAWI, B.V.Sc., M.V.Sc. (Cairo), Ph.D. (London). 480

Correspondence 484

Reviews 484

Notices 486

NOTICE TO CONTRIBUTORS

Please turn to the inside back cover of this **Journal** *for particulars regarding submission of articles to the Editors.*

FOUR IMPORTANT BOOKS

DISEASES OF CATTLE

Edited by Finaher, Gibbons, Mayer and Park

Twenty-five chapters covering Physical Examination, Laboratory Examination, Administration of Medicines, Nutrition, Diseases of Calves, The Respiratory System, The Circulatory System, The Digestive System, The Urogenital System, The Blood and Blood-Forming Organs, The Locomotor System, The Skin, Artificial Insemination, Diseases Due to Physical Agent, Toxicology, Bacterial Diseases, Leptospirosis, Viral Diseases, Protazoan Diseases, Diseases of Metabolism, Miscellaneous and Unclassified Diseases, Salvage Through Slaughter and Herd Management.

57 AUTHORS - 762 PAGES - 234 ILLUSTRATIONS - PRICE128s.

CANINE SURGERY

New Revised Fourth Edition

Thirty-one chapters completely revised. Anatomy, Physiology, Healing and Repair, Surgical Principles, Sterile Technic, Sutures and Ligature, Approach and Restraint, Anæsthesia, Pre-surgical care, Wound protection, Physiological Consideration of Some Postoperative Conditions, The Skin, Dental Surgery, The Mouth, The Tonsils, The Larynx and Trachea, Sublingual and Submaxillary Salivary Cyst, The Nose, The Ears, Eyes and Eyelids, The Thyroid Gland, The Neck, The Thorax, The Abdomen, The Genito-urinary System, The Mammary Glands, The Anus and Rectum, The Legs, Fractures, Luxations, and Cosmetic Surgery.

30 AUTHORS - 816 PAGES - 600 ILLUSTRATIONS - PRICE 144s.

PATHOLOGY
OF THE DOG AND CAT
(GENITO-URINARY SYSTEM)

by Frank Bloom, D.V.M.

A valuable book for the clinician who knows that the tendency to transfer conclusions based upon valid human genito-urinary pathology to the dog and cat has resulted in errors both in diagnosis and treatment. Out of his twenty-five years of experience in practice and teaching, Dr. Bloom writes with authority. The genito-urinary organs are described on a systematic basis. For each organ the normal, gross and microscopic anatomy is described and then compared to the pathological under the headings of: Congenital Anomalies; Circulatory Disturbances; Trauma; Regressive Changes; Inflammations; Primary and Secondary Tumors and Parasites. A comprehensive discussion of the canine prostate is included.

480 PAGES - 312 ILLUSTRATIONS - PRICE 96s.

CANINE MEDICINE

New Revised Second Edition ***Ready October***

Twenty-eight chapters embracing Clinical Examinations, The Administrations of Medicines, Nutrition, The Digestive System, The Respiratory System, The Urogenital System, The Blood and Blood-Forming Organs, The Heart, The Endocrine Gland, The Anatomy of the Skin, The Skin, The Locomotor System, The Ear, The Eye, The Nervous System, The Allergies, Metazoan Infections, Mycotic Diseases, Rickettsial, Spirochetal, Bacterial and Viral Diseases, Diseases Caused by Physical and Toxic Agents, Gerontology, Pediatrics, Euthanasia, Parenteral Fluid Therapy, and Inhalation Therapy.

The contents of this edition, will be more than 60% all new.

52 AUTHORS - 724 PAGES - 261 ILLUSTRATIONS - PRICE 144s.

PUBLISHED BY AMERICAN VETERINARY PUBLICATIONS INC., SANTA BARBARA, CALIF. U.S.A.

OBTAINABLE FROM

Baillière, Tindall & Cox, 7 & 8 Henrietta St., London W.C.2

THE BRITISH VETERINARY JOURNAL

EDITORS :
J. McCUNN, *F.R.C.S., L.R.C.P., M.R.C.V.S.*
R. LOVELL, *D.Sc., Ph.D., M.R.C.V.S., D.V.S.M.*
SIR THOMAS DALLING, *M.A., D.Sc., F.R.C.V.S., F.R.S.E.*

Vol. 114 **December, 1958** **No. 12**

The whole of the matter appearing in "The British Veterinary Journal" is Copyright and may not be reproduced in whole or in part without permission.

EDITORIAL

THOUGHTS ON THE END OF A YEAR

The span of a man's life may cover many years and yet it is but a dot in the infinity of time. From birth to death he is never free from perils which may disturb or foil the even tenor of his way. The hazards can be of an intimate personal nature and manifested in ill health of mind or body, they may stem from circumstances associated with his environment, be engendered by family or economic factors, or it may be that the victim is one on whom Fortuna has not deigned to smile. The journey through life can be likened to a point-to-point race. It calls for great stamina, pluck and endurance, for there are many obstacles on the course and the manner in which these are approached and surmounted serves as a measure which betokens ultimate success or failure.

A year is a unit in the successive state of time; each has a beginning, then surges to maturity and having blossomed dies. As the years pass by in panoramic sequence and each one comes to its destined end, it is well to tarry awhile, and enquire how one has fared in the race so far. Are we satisfied with the progress which has been made, have we taken advantage of all the opportunities which have been displayed, have we added to the sum of knowledge and have we made any contribution to the welfare of mankind? He who can make answer in the affirmative is a happy man indeed even if his assessment be born of error. A critical appraisement of the records of the past can be of the utmost value not only in the assessment of one's present state but as a guide to future action. What better time can there be for this interrogation than at the close of the year?

In world affairs 1958 has not been dissimilar to its immediate predecessors and discord amongst the nations still holds sway. Fortunately there has not been a major clash of arms, the altercations have been conducted in a battle of words. As long as the antagonists are content to talk, argue and hurl abuse into the air, no matter how vituperative are the words they use, the anxious world can take another breath and rest in a modicum of peace.

In the field of veterinary endeavour the profession has experienced another year of full employment and prosperity. In spite of the continued increase in the number of new graduates there are still more jobs available than there are the men to fill them. Young graduates can " play the market " to their own financial satisfaction and

XUM

often to the embarrassment of their would-be employers. The great scheme for the erradication of bovine tuberculosis is nearing completion. This remarkable achievement has been one of the main causes of the present condition of full employment. There is no doubt that this great biological adventure has focussed attention on the value of applied veterinary science. It has raised the status of the profession in the public esteem and in scientific circles. Its very success has raised one small cloud in a fine blue sky. It is to be expected that, when the task is completed and all our cattle are attested, the spate of work, which has been poured out in recent years, will show some abatement in its flow. There may be a danger that, if some other avenue of endeavour is not opened up, the state of full employment may experience a decline. Let us hope that this idea will prove to be a mirage. If some degree of unemployment should come to pass the problem must be tackled by the profession with the same vigour as it has shown on similar occasions in the past. If one door closes there are others which can be opened and few professions have so many avenues to explore or fields in which to graze.

As Christmas approaches mundane thoughts vanish and our minds turn instinctively to good will and cheer and to friends of past and present times. We think especially of those who have fared ill in the race of life. The spirit of Christmas is centred deeply in the family and home. A profession should be as one big family and it is the privilege and duty of its members to succour their colleagues who fall on evil times and are in trouble or distress. There are many who, through no fault of their own making (and that would be no excuse for failing to give a helping hand), are in straitened circumstances. To them Christmas, which should be a time of joy, good companionship and pleasant memories, can be a sad and sorry time. Their table will not groan with good things to eat and drink, for want of fuel no fire will blaze on the hearth, and they may be very lonely unless their friends and colleagues remember them and come to the rescue. Let good will, friendship and benevolence burn brightly in our hearts so that we will spare a thought for our colleagues in trouble and distress and see that none are forgotten, are lonely or in want this Christmastide. Remember " There, but for the grace of God, go I ".

A letter is appearing in the Correspondence Column to which we particularly draw our readers' attention.—Ed.

OBSERVATIONS ON SOME ASPECTS OF THE CORTICOSTEROIDS IN SMALL ANIMALS

R. H. GLOVER, M.R.C.V.S.

Dr. Hans Selye, M.D., states in his book " The Stress of Life " that the release of the corticosteroids from the adrenal cortex are brought about as a normal response to stress, or rather to a stressor. The action of these substances follows a clearly defined pattern, no matter what the stressor agent may be. This pattern to which Dr. Selye has given the designation general adaptation syndrome, or G.A.S., causes three things to happen.

1. Hypertrophy of the adrenal cortex. 2. Shrinking of the thymus, spleen, lymph nodes and all other lymphatic structures. 3. Gastric disturbance, sometimes to the stage of haemorrhage and ulcers.

It was sometime before Dr. Selye discovered that the above syndrome was caused by the hormone of the adrenal cortex. Having done so, he then discovered that these were activated by ACTH from the pituitary. Throughout a long series of experiments, the properties of these hormones was slowly determined and is still being determined, but the outstanding feature of them is the remarkable anti-inflammatory action that they possess. Working upon the theory that all stressors, whether viral, bacterial, cold, heat, trauma, etc., cause inflammation either local or general, it was a logical step to investigate their action in generalised and local inflammatory conditions, and this has led to the accepted use and value of the corticosteroids in a variety of recognisable inflammatory conditions. In so far as small animal medicine is concerned, these are mainly non-specified dermatoses, allergic manifestations such as bronchial asthma, certain ocular and aural inflammations both suppurative and non-suppurative, arthritis, intervertebral disc syndromes, snake bite and shock. It is a logical assumption that, as the corticosteroid disperses the inflammatory barrier, this could be dangerous in certain diseases which can lie dormant by virtue of the barrier around them caused by the sealing off process of the body's natural defences. The outstanding example of this is tuberculosis. In this disease the corticosteroids will make matters worse by breaking down the barriers surrounding the tubercles.

In order to overcome an infected inflammatory condition, such as a suppurative otitis, therefore, it is desirable, and indeed necessary, to introduce an antibiotic as well. Furthermore, it is generally agreed that the effectiveness of the antibiotic, if used in normal therapeutic doses, will be reduced in the presence of the corticosteroids, so that it is important to use the antibiotics in a much higher dosage than usual. If this is done, then the resulting cure will be more rapid and effective.

Conversely, if the inflammation is of a non-infectious nature and there is no other disease present, then the corticosteroid alone, either locally as an ointment, or systemically by oral dosage, or by intramuscular injection, will effect a cure; such conditions being arthritis, prostatitis and shock.

Opinion as to the effectiveness of the corticosteroids in combating some of the infectious diseases, notably the distemper complex, are varied. For instance, Candlin F.T., states that he has achieved good results in the treatment of infectious hyperkeratoses (36 dogs cured out of 51 treated). (Candlin F.T. (1954) North Am. Vet. *35*: 764-768). Whereas, Munroe W.P., states that he has obtained a no higher

percentage of cures using the corticostoids than he had done by not using them. (Monroe W.P. (1952) Personal Communication cited). The present author is inclined to agree with Munroe, as his observations using corticosteroids both in early and late cases of this disease, have proved singularly disappointing. However, Bunce has claimed satisfactory results in various nervous disorders, including chorea, which is generally accepted as a sequel to the distemper complex. (Bunce D.F.M. (1954) Vet. Med. *49*: 537-542). He claims that of 470 dogs treated for nervous disorders, including posterior paralysis, 338 fully recovered, 38 showed considerable improvement and 94 failed to respond to treatment. A significant feature of Bunce's treatment was the addition of massive doses of vitamin B.12. It seems reasonable to assume that in his series of cases the corticosteroid acted in a synergistic manner with the vitamin B.12, and that the corticosteroid, by allaying stress, enabled the vitamin B.12 to act more powerfully upon the nervous system.

Bunce further states that treatment with corticosteroid was of no benefit in leptospirosis, infectious canine hepatitis and non-specific virus infections. These last observations are interesting to the present author for two reasons. Firstly, is it possible to recognise a disease as being a non-specific virus infection? Admittedly there are certain cases of virus type infection which do not fit clearly into the distemper hepatitis group, but are apparently mixtures of these diseases, and which will usually respond, if they respond at all, to accepted lines of treatment. Perhaps Bunce is referring to this type as non-specific. However, Selye states that all diseases are non-specific until proved specific. Secondly, it has been the present author's experiences that in a fair proportion of hepatitis cases the corticosteroids will help to a marked degree.

Attention was first drawn to the possible benefits of using corticosteroid therapy in some infectious diseases when, in December 1957, a Siamese cat suffering from panleucopoenia was presented. This cat made no progress whatever with antiserum, chloromycetin or auromyecin in that order. After four days the cat was virtually dead, and would have been put to sleep had not the owner asked for a little longer time. Consequently, 20 mgm. prednisolone was injected intramuscularly at 10.30 a.m. without much hope of achieving anything. (It was not realised at this stage how the corticosteroids could alleviate stress and shock). At 4 p.m. the owner rang up to say that the cat had virtually arisen from the dead four hours after the injection, and was then walking around the house, demanding food. 10 mgm. prednisolone was injected once daily for the next four days, and the cat steadily improved and is now as fit as ever he was. This experience has been repeated in two other Siamese cats and three half-breed Siamese, with equal success. No other supportive treatment has been used. The next interesting feature in this particular outbreak of panleucopoenia was the fact that cortiocsteroids worked to an almost miraculous degree in Siamese and half-breed Siamese, but was very disappointing in its action in ordinary ' back alley cats ', in which it had no appreciable effect. No satisfactory explanation for this can be offered.

In so far as infectious canine hepatitis is concerned, the normal practice has been to use anti-serum in the first instances with 75% success. Prednisolone was first tried in the disease in January 1958 in a case of hepatitis in an Alsatian which failed to respond to antiserum, 20 mgms. being injected on the third visit when the dog was

XUM

quite prostrate. The following day, the dog came out to greet me wagging her tail and never looked back. Twelve further cases have been treated in this fashion, with similar success — all having recovered with a combination of anti-serum and prednisolone.

Little reference can be found about the effect of the corticosteroids on the white cells, except that according to Henry, Oliner and Ramey, a dose of 3 mgm/kg. will produce an eosinopoenia to as much as 50% of normal in dogs, which certainly accounts for its action in non-specific dermatoses which are characterised by eosinophilia. (Henry W. L., Oliner L. & Ramey E. R. (1953) Federation Proc. *12*: 66). Luke states that he obtained an initial lymphopoenia followed by a slight increase then a return to normal in 74 hours; Selye supports this finding. (Luke D. (1953) Brit. Vet. J. *109*: 434-436). This, coupled with the fact that doses of 10 mgm/kg. per day for a period of two or three weeks have shown, at autopsy, atrophy of the adrenal, thyroid and lymph nodes, may account for the fact that in the following case of lymphatic leukaemia, all the superficial lymph glands have subsided to a non-palpable state, but in itself does not account for the remarkable return to health of this particular case, nor for the fact that throughout, the lymphocyte count has increased rather than diminished.

This dog — a 10 years old Scottie male — was first seen in September, 1957, and was suffering from what was then thought to be pseudo Hodgkin's disease, all the superficial lymph glands being greatly enlarged and the dog in an extremely listless condition. Initial treatment, which proved of no use, was vitamin B.12 and iron dextran injection. In November 1957, two blood transfusions were given which had an immediate beneficial effect, causing the glands to subside to an appreciable extent and making the dog obviously feel better. There was a severe reaction after the second transfusion that gave cause for alarm, and it was decided that further transfusion could be dangerous. However, the dog recovered from the shock and continued in his improved health, but vision was poor and he tired very easily. On 10th December, 15 mgm. prednisolone was injected and this caused an almost immediate spectacular further reduction of the lymph glands. 10 mgms. prednisolone was injected daily throughout December 1957, and January 1958, with a steady improvement in health and vigour, and return of vision. Then the injections were extended to one every two days during February 1958, and gradually trailed off until, by early May, one only was given every two/three weeks. Throughout the period, the dog's health was steadily improved, and he became like a young puppy in his attitude to life and in his behaviour. Also throughout the period blood samples were submitted to the laboratory, and these showed a steadily mounting lymphocyte count. On 23rd April 1958, a biopsy was taken of one of the popliteal glands at the Royal Veterinary College, together with a further blood sample. Mr. Irfan, reported the blood picture to be then one of typical chronic lymphatic leukaemia. This dog is still alive and very active. No satisfactory explanation can be offered, and it is fully appreciated that this one case cannot prove much — except that dogs do suffer from lymphatic leukaemia, and that perhaps the corticosteroids can help them, as they certainly do in the other diseases mentioned.

The prednisolone used in this work was Deltacortril Intramuscular supplied by Messrs. Pfizer of Folkestone.

XUM

STUDIES ON INTERVERTEBRAL DISC PROTRUSION IN THE DOG

by

L. C. VAUGHAN, F.R.C.V.S.

Department of Surgery, Royal Veterinary College, Hawkeshead House, North Mimms, nr. Hatfield, Herts.

4. TREATMENT

The aetiology and pathogenesis, the diagnosis, and the pathological features of intervertebral disc protrusion in the dog have been discussed in previous papers by the present author (Vaughan, 1958a, b, c). One further aspect of the disease, namely the treatment, remains to be considered. It is by no means unusual for dogs to recover spontaneously from the effect of a protruded disc even though the signs and symptoms exhibited includes locomotor dysfunction up to the point of paraplegia. For this reason most cases are treated by conservative measures in the first instance. In most cases it is not until this form of treatment has failed that surgical treatment is undertaken and by this time vital nerve structures may have become damaged irreparably.

Medical Treatment

This is symptomatic and depends to a great extent on the signs and symptoms displayed by the dog. The dose and frequency of administration of sedative or analgestic drugs for the relief of *regional pain* depends on the severity of the latter and whether it is constant or intermittent. In addition anything which might cause a further extrusion of nuclear material and exacerbation of symptoms must be avoided. For this reason the dog should be confined or its exercise controlled for some time after apparent recovery. Straining associated with defaecation may be controlled by the administration of medicinal paraffin. Good nursing of patients with *ataxia* or *partial paraplegia* will do much to prevent excoriation of the dorsal aspect of the feet. In cases of *paraplegia* attention must be given to the evacuation of bowels and bladder and the avoidance of bed sores. When the dog is admitted to hospital it is advisable to give a course of antibiotic to check infection of the urinary tract. The bladder should be emptied at least twice daily by gentle abdominal pressure and the urine examined macroscopically for evidence of cloudiness or blood. Small doses of medicinal paraffin should be given only when necessary. If the faeces become semi-fluid special attention should be given to the hygiene of the skin of buttocks and thighs. The hindquarters of the long-haired breeds should be clipped. Dogs with urine and faecal incontinence should be washed frequently. The wet regions should be dried thoroughly and dusted with talcum powder. It is a fortunate circumstance that sphincter control is often regained in from 7-14 days. The diet should be light and nutritious.

Whilst no drug has been proved to be significantly successful in the treatment of this type of paraplegia, it is thought that Vitamin B_1 plays some part in improving the metabolism of nervous tissue.

After the initial rest period of approximately 7-10 days manipulation of the hind legs and gentle massage of the thigh muscles is indicated to combat muscle atrophy.

XUM

When muscle tone and the spinal reflexes have improved the dog should be supported and encouraged to assume the standing position several times daily and given ambulatory exercise if possible.

The results obtained by conservative treatment in the present investigation are summarised as follows: —

Three dogs with slight cervical pain recovered in 2-7 weeks, but of 7 dogs with intense pain 6 were unchanged after 16-28 days and were treated surgically. One of the latter was destroyed at the owner's request after 10 days. Of 6 dogs with quadriplegia, 3 were destroyed soon after the onset of symptoms; one recovered in 19 days; one died; one was unchanged after 15 days and was treated surgically. Of 16 dogs with lumbar pain, ataxia or paresis, 12 recovered in 1-2 weeks; 2 were destroyed at the request of their owners; 2 were unchanged after 3-4 weeks and were treated surgically. Of 33 dogs with paraplegia, 6 recovered partially or completely; 14 were destroyed in from 1-455 days after the onset; 6 died; 7 were treated surgically.

Surgical Treatment

The operative procedures which may be adopted are *Laminectomy* and *Disc fenestration.*

Laminectomy

The removal of the protrusion from the spinal canal before the effects of cord compression are advanced would appear to be the ideal concept. Access to the spinal canal is gained by means of a "laminectomy" operation in which the roof of the canal, in the region of the protrusion, is removed. An incision is made through the skin in the dorsal midline with its centre opposite the anticipated site of the protrusion. The lumbo-dorsal fascia is divided close to and on each side of the dorsal spines. The attachments of the spinal muscles to the lateral aspects of the dorsal spines are incised immediately against the latter. Considerable haemorrhage accompanies the muscle separation which must be made right down to the vertebral laminae. All haemorrhage must be controlled before the spinal canal is opened. Three dorsal spines, the centre one opposite the protrusion site, are removed at their bases with bone forceps. A self-retaining retractor is introduced. An opening is made with a hand drill into the spinal canal through one of the most posterior laminae. It is not advisable to enter the canal directly over the protrusion since at this site the cord may be elevated against the inner aspect of the laminae and liable to injury. With the drilled opening as a starting point the laminae are removed with nibbling and laminectomy forceps. The spinal cord is thus exposed and it can be retracted gently to permit the removal of the extrathecally protruded disc material. During the latter procedure great care should be exercised in order to prevent the puncture of a venous sinus. Wound closure is accomplished in three layers. The spinal muscles and the fascia are apposed with fine catgut and the skin with nylon thread.

This technique, while not very difficult, is fraught with possible danger to the spinal cord. In the dog there is very little room between the cord and the bony canal and for this reason direct bruising of the cord may occur at the time of laminal resection or during removal of the protrusion. Haemorrhage into the canal as a result of accidental puncture of a venous sinus or seepage from the incised muscles could

XUM

give rise to serious cord compression. During wound healing granulation tissue becomes adherent to the dura mater and it is conceivable that this may lead to a compression of the cord.

The author has performed laminectomy on three dogs with disc protrusion; two totally and one partially paraplegic. The latter became paraplegic as a result of the operation. All three were eventually destroyed as function in the hind limbs did not return. When examined after death the dura was adherent to fibrous tissue of the wound in each case, but the cord did not appear to be compressed.

Olsson (1951a) treated three dogs with disc protrusion in similar fashion but removed only half of the neural arch (hemilaminectomy). Two of these dogs showed pain and slight paresis but became paraplegic after the operation and improved only slightly after two months. The third which was paraplegic at the time of operation improved slightly after two months.

Hemi-laminectomy has also been performed by Greene (1951). From his experience of the operation on dogs with disc protrusion he stated that " no improvement should be expected in less than 30 days ". No details, however, were given of the number of dogs treated or the results obtained.

Laminectomy or hemi-laminectomy was performed experimentally on 14 normal dogs by Key and Ford (1948). Post-operatively 7 dogs showed varying degrees of hind limb paralysis although five recovered eventually. Similarly, Redding (1951) found 10 normal dogs, which had been subject to laminectomy, were paralysed to some degree the day after the operation. Nine of these dogs were able to walk in from 1-6 days. One did not recover after 90 days and in this case there had been laceration of a venous sinus during the operation.

It is apparent that there is a risk of injury to the spinal cord during the operation of laminectomy, even when it is performed on normal dogs. In the dog with disc protrusion the risk is greater since the cord is already involved in the acute inflammatory reaction which accompanies disc protrusion, and is bruised more readily and it is less able to adapt itself to further compression.

With present techniques, laminectomy is altogether too hazardous to be recommended in the treatment of a dog with disc protrusion. In the writer's opinion, a very limited laminectomy in which cord exposure is kept to the minimum may prove both feasible and useful.

Disc Fenestration

This technique was introduced by Olsson (1950, 1951a) for the treatment of disc protrusion in the dog. An incision is made through the annulus fibrosus into the nucleus pulposus and the remainder of the nucleus of the disc, after protrusion has occurred, is removed through the fenestration wound. As the procedure is accomplished external to the spinal canal the risk of injury to the cord is negligible. The material which has protruded into the spinal canal is not interfered with. The approach to the disc depends on its regional situation.

In the cervical region an incision is made through the skin in the ventral midline starting at the larynx and extending posteriorly along the line of the trachea. The right and left sternohyoideus muscles, which overlay the trachea, are separated. The ventral aspect of the spine, covered by the longus colli muscles, is exposed by blunt dissection. Adequate exposure is maintained by introducing a retractor to draw the trachea away

XUM

PLATE 1

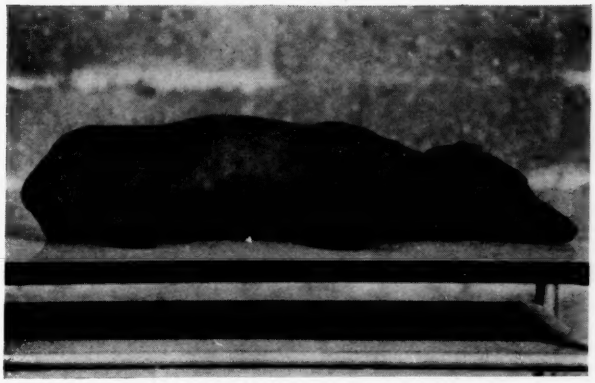


FIG. 1
5 years old Dachshund with quadriplegia. 2/3 and 3/4 cervical disc protrusions.

FIG. 2
Same dog as in Fig. 1 20 days after fenestration of affected discs.

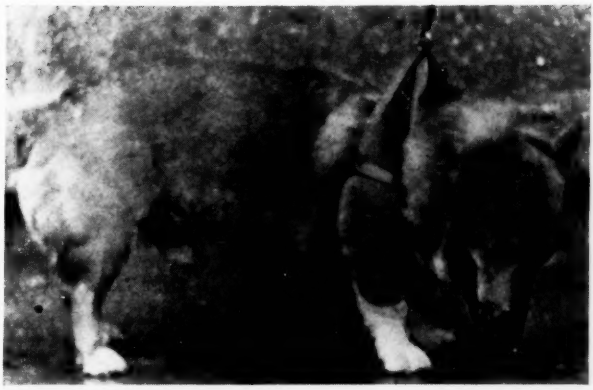


FIG. 3
6 years old Corgi with acute cervical pain. 3/4 cervical disc protrusion.

(Article by L. C. Vaughan on pages 458-463)

XUM

PLATE 2

FIG. 4
Same dog as in Fig. 3 12 days after fenestration of affected disc.

FIG. 6
Same dog as in Fig. 5 27 days after fenestration of affected disc.

FIG. 5
4 years old Spaniel with acute cervical pain and flexion of right fore limb. 2/3 cervical disc protrusion.

(Article by L. C. Vaughan on pages 458-463)

XUM

from the operator. Since the trachea is compressed in the process an endotracheal tube must be inserted in order to provide adequate lung ventilation. The disc to be fenestrated is located by counting the vertebrae posterior to the atlas. As the ventral spines of the cervical vertebrae are prominent it is not difficult to keep to the midline. Little separation of the longus colli muscles is necessary and haemorrhage is therefore minimal. Each disc is situated immediately posterior to the summit of a ventral spine. With a fine bladed knife the ventral annulus is punctured vertically and, with a sawing action, a circular piece is excised. Through this opening (fenestrum) the remaining nucleus can be removed entirely with a fine scoop. Calcification of the nucleus does not present any special difficulty. Wound closure consists of apposing the sternohyoideus muscles and skin.

The thoraco-lumbar discs posterior to the 12th thoracic vertebra are reached from their dorso-lateral aspect. The approach is similar to that employed for laminectomy except that in this case it is unilateral and the muscles are separated from the vertebrae down to the level of the transverse processes or ribs. It is not possible to fenestrate the 11/12th thoracic disc or those cranially by this route as they are covered dorso-laterally by the ribs. The operation can be accomplished by the transthoracic approach. The author has fenestrated lumbar discs from their ventral aspect via the abdomen. While this method is convenient in small, thin dogs with shallow abdomens, it is extremely difficult in large dogs and those in fat condition.

Hansen and Olsson (1953) provided information on the use of the disc fenestration operation in 56 dogs with varying symptoms of disc protrusion. These dogs were observed post-operatively for at least one year. Of 15 dogs with pain of varying degree 13 recovered (2 relapsed but recovered again) and 2 died from intercurrent disease. Of 9 dogs with pain and slight paresis 8 recovered (3 later relapsed and were destroyed) and one improved. Of 11 dogs with pain and grave paresis 9 recovered (3 later relapsed and were destroyed) and 2 improved. Of 21 dogs with paraplegia 3 recovered (1 relapsed and was destroyed), 5 improved, 7 were destroyed because of little or no improvement and 6 died from intercurrent disease. These authors (1952) also recorded the complete recovery, after fenestration, of 4 dogs with cervical disc protrusion. Douglas (1955), in an article principally concerned with myelography, recorded the affect of fenestration on 4 dogs. Of 3 dogs with cervical pain 2 responded to the operation, as did one dog with lumbar pain and ataxia.

In the present investigation 13 dogs were treated by disc fenestration and the details are recorded in Table No. 1. All 7 dogs with cervical protrusions (one was quadriplegic and 6 suffered intense cervical pain), recovered in from 6-42 days. The operation was employed successfully on two occasions in one dog in which there was a recurrence of pain caused by the protrusion of a cervical disc which had not been affected previously. Of 4 dogs with paraplegia, 2 were destroyed after four months although one dog had improved slightly; one died 24 hours after transthoracic fenestration; one died 7 days after operation and at autopsy gross cord damage was found. Of 2 dogs with lumbar pain and paresis, one recovered and one died from respiratory failure 24 hours after the operation.

TABLE 1.

Details of 13 dogs treated by Disc Fenestration.

Dogs	*Symptoms*	*Pre-operative period of Conservative Treatment*	*Disc Fenestrated*	*Sequel*
Dachshund	Quadriplegia	15 days	2/3, 3/4, 4/5, C.	Recovery in 12 days
Corgi	Cervical pain	21 days	2/3, 3/4, 4/5, C.	Recovery in 6 days
Spaniel	Cervical pain	23 days	2/3, 3/4, C.	Recovery in 21 days
Dachshund	Paraplegia	46 days	1/2, 2/3, L.	Just able to stand in 4 mths. Destroyed.
Spaniel	Cervical pain	17 days	2/3, 3/4, 4/5, C.	Recovery in 7 days
Spaniel	Cervical pain	25 days	2/3, 3/4, C.	Recovery in 11 days
Peke	Cervical pain	28 days	2/3, 3/4, 4/5, C. & later 56, 6/7 C.	Recovery in 10 days Relapse — recovery in 7 days
Spaniel	Paraplegia	35 days	10/11, 11/12, 12/13 Th.	Died 24 hours later —lung collapse
Spaniel	Cervical pain	16 days	2/3, 3/4, C.	Recovery in 42 days
Corgi	Paraplegia	6 days	13 Th/1 L.	Died 7 days later— gross damage to spinal cord.
Dachshund	Paraplegia	18 days	13 Th/1 L. 1/2 L.	Paraplegia unchanged in 4 months. Destroyed.
Dachshund	Lumbar pain & paresis	21 days	13 Th/1 L.	Recovery in 7 days
Dachshund	Lumbar pain & paresis	28 days	13 Th/1 L, 1/2 L.	Died 24 hours later respiratory failure.

Discussion

The evaluation of disc fenestration is made difficult by the possibility of spontaneous recovery and the fact that in most instances surgery is not adopted for some time after the onset of signs and symptoms. It is questionable whether the operation can effect a reduction in the size of the protrusion. If the dorsal annulus is ruptured, as in a Type 1 protrusion, the only material which might reasonably be expected to regress into the fenestrated disc is that which has remained at the rupture site. The small size of the rupture and the semi-solid nature of the protruded material makes regression unlikely. Three calcified protrusions (in 2 dogs) which disappeared after fenestration were presumed to have been resorbed. Regression of a Type 2 protrusion is feasible since in these cases the dorsal annulus in intact and removal of the nucleus will relieve the pressure inside the disc. By means of the fenestration operation it is possible to prevent a further extrusion of the nucleus; it allows of a release of pressure which during spinal movements has been acting on the protrusion; it reduces the risk of relapses if adjoining discs are fenestrated (Olsson 1951a). It is chiefly indicated in

dogs with symptoms of pain and/or limited locomotor dysfunction (as the result of a cervical or a thoraco-lumbar protrusion) which have not responded to a period of conservative treatment and in these cases it will prevent a further deterioration. Hansen and Olssen (1953) also considered that fenestration may be indicated in dogs with slight or medium acute symptoms "in order to hasten the course of healing, to prevent an aggravation of the symptoms and to reduce the risk of relapse". According to these authors the operation is contra-indicated in dogs with "grave" symptoms and those in poor general condition. Further, they do not recommend the operation in dogs with a large number of calcified discs since the risk of relapse is great. The present author cannot reconcile the last observation with the fact that relatively few calcified discs also protrude, and would not advise against the operation on this ground alone. The use of disc fenestration as a last resort in chronic cases with severe symptoms is not justified since the chance of success is negligible.

REFERENCES

Douglas, S. W. (1955). *Vet. Rec., 67,* 75.
Green, J. E. (1951). *N. Amer. Vet., 32,* 411.
Hansen, H. J. and Olsson, S. E. (1953). International Veterinary Congress, Stockholm.
Key, J. A. and Ford, L. T. (1948). *J. Bone Jt. Surg., 30,* 621.
Olsson, S. E. (1950). *Nord. VetMed., 2,* 1074.
——— (1951a). *Acta orthopaed. scand., Suppl.* 8.
——— and Hansen, H. J. (1052). *J. Amer. vet. med. Ass., 121,* 361.
Redding, W. R. (1951). *Amer. J. vet. Res., 12,* 123.
Vaughan, L. C. (1958a). *Brit. vet. J., 114,* 105.
——— (1958b) Ibid, *114,* 203.
——— (1958c) Ibid, *114,* 350.

OBSERVATIONS ON THE DISTRIBUTION OF BIREFRINGENT CRYSTALS IN THE ADRENAL GLAND OF THE SHEEP

by

W. M. STOKOE, B.Sc., M.R.C.V.S.

Department of Veterinary Anatomy, Royal (Dick) School of Veterinary Studies, University of Edinburgh.

The morphological appearance of a gland is not always a true record of the functional status of that gland, and this statement applies especially to the adrenal. For this reason, in an effort to gain more precise information regarding the activity of the adrenal as a whole, and to gauge adrenocortical activity, recourse has to be made to histochemical techniques, consideration of variations in the amount of liquid present and differences in the size of fat globules.

In the adrenal cortex, fat is made up of a mixture of cholesterol and its esters, the palmitic, stearic and oleic esters of glycerol, and the actual steroid hormones

XUM

themselves (Pearse, 1953). Whilst the most usual dyes for routine demonstration of lipid are the sudans and osmic acid, the extent of sudanophilia and osmophilia purporting to give an estimate of the functional status of the gland, certain other techniques have been evolved which depend upon the fact that adrenocortical hormones have a reactive ketone group in their make-up. Amongst such techniques is the 2,4-dinitrophenyl-hydrazine reaction which, whilst not being strictly specific for adrenocortical steroids, was used extensively by Bennet (1940) and the plasmal reaction which is reputed by Albert and Leblond (1946) to give positive results in the presence of the steroids of the adrenal.

The Liebermann-Burchardt reaction and its modification the Schultz reaction yield a blue-green colour in the presence of cholesterol and its esters which are now considered by most observers to be the possible precursors of adrenocortical hormones for Sayers and Sayers (1948) have shown that, in the rat, variations in the total cholesterol content of the adrenal correspond directly to functional changes in the gland, and it has been observed by Yoffey and Baxter (1949) and Cain (1950) that whilst those areas in the adrenal cortex which demonstrate a sudanophilia need not coincide with those giving the plasmal and phenylhydrazine reactions, the differing distributions often have a bearing, however imprecise, on the functional state of the adrenal.

Whilst being of no use in distinguishing adrenocortical steroids, one of the most valuable methods for demonstrating the presence of cholesterol in tissues is the Windhaus (1910) digitonin reaction during which the monatomical alcohol is precipitated and the resulting crystals can be examined with the aid of a polarising microscope. This technique has been used extensively by workers such as Leulier and Revol (1930) and various adaptations of the technique by Weaver and Nelson (1943), which workers also claim that the quantitative and qualitative distribution of cholesterol in the adrenal as demonstrated by its birefringent properties is intimately associated with the production of adrenocortical hormones.

The presence of such birefringent material in the adrenal cortex was first noted by Kaiserling and Orgler (1902) but it was not till Albrecht and Weltmann (1911), using frozen sections of formol-fixed human glands, found abundant spherical crystals in the cortices of these glands that the idea of the association of these crystals with cholesterol came about. Landau and McNee (1914) noted the presence of birefringent material in the adrenal cortex of rabbits and, bearing in mind the findings of Albrecht and Weltmann, stated that they could correlate the amount of such material with the cholesterol content of the gland.

Bennet (1940) in addition to making use of the histochemical techniques mentioned above also noted birefringent crystals in the adrenal cortex of the cat and suggested that these crystals were for the most part due to the presence of cholesterol. Yoffey and Baxter (1947) found that in the rat and cat the region of maximal crystal formation was the outer portion of the Zona Fasciculata and also that this region coincided with that portion of the cortex which yielded most strongly positive results with the phenylhydrazine reaction.

Accordingly in view of the possible light which the formation of birefringent crystals might throw on the distribution of cholesterol in the adrenal gland of the Sheep, it was decided to investigate their presence and zonal concentrations.

XUM

Materials and Methods

The Sheep used for pursuance of this study were obtained from the City Abattoir, Edinburgh and the glands from twelve half-bred animals of approximately nine months of age were examined. At the start of the investigation, very inconclusive results were obtained with regard to the detection of birefringent material in the glands. Frozen sections of formol-fixed glands which had been immersed in fixative at room temperature for one week were mounted unstained in glycerol-gelatine and examined in polarised light. The birefringent crystals of cholesterol esters when treated in this way are said to show brightly against a dark background. Whilst some evidence of fibrillar birefringence was noted in the capsule, there was no obvious crystallization in the cortex. Accordingly the technique of Leulier and Revol (1930) was attempted, glands being immersed in alcoholic-digitonin solution after formol fixation. Leulier and Revol state that the resulting cholesterol-digitonin complex forms birefringent crystals which are admirably evident under the petrographic microscope but, whilst strengths of digitonin from 1 to 10 per cent in varying percentages of alcohol were used, the results obtained were as disappointing as when the glands were examined without previous treatment with digitonin.

From the lack of observations obtained with Leulier and Revol's technique it was thought that the presence of alcohol, in however small a percentage, might remove some of the adrenocortical lipids. Accordingly, an aqueous solution of digitonin was prepared after Bennet's (1940) method. One gram of digitonin was dissolved in a litre of distilled water and the solution warmed to 60-70 degrees C. for a period of one hour. The solution was then cooled and allowed to stand in a refrigerator overnight, after which it was filtered and evaporated in a water bath to 400 cc. giving a 0.25 per cent solution of digitonin in water.

The adrenals were removed from two freshly-killed Sheep and fixed in a 10 per cent formol bath for 24 hours at 37 degrees C. The glands were then washed several times during the following 48 hours, care being taken to keep the temperature constant at 37 degrees C. Immersion for five days in a warm aqueous solution of digitonin followed, after which the glands were again washed thoroughly many times with warm distilled water. They were then transferred to a freezing microtome and sectioned at 25 mu. The sections were then mounted in syrup of laevulose and studied with a petrographic microscope.

Latterly two techniques suggested by Yoffey and Baxter (1947) which obviate the need for digitonin and which yield equally rewarding results, were followed:

(i) Glands were fixed in 10 per cent neutral formol-saline then sectioned at 10-15 mu. on a freezing microtome. The sections were then mounted in either syrup of laevulose or Zwemer's (1933) Glychrogel,

(ii) Glands were embedded in gelatine subsequent to fixation in 10 per cent formalin and then sectioned on a freezing microtome.

Encouraging results were obtained by both methods and sections were examined in the unstained condition.

XUM

Results

When a tissue is examined with a petrographic microscope the optically inactive portions appear either red, dark-grey or black according to the amount of rotation of the polariser. Optically active portions of the tissue are birefringent and appear brightly illumined against the dark background of the optically inactive tissue. Thus when sections of Sheep adrenal are examined after processing by the techniques mentioned above, the cortex can be divided into four distinct zones:

(i) The outer or subcapsular zone comprising the Zona Glomerulosa is relatively sparse in birefringent material as compared with the inner optically active zones of the cortex (Fig. I). What optically active material is present within this outer zone consists of a fine granular scattering of crystals which appear to have a uniform distribution throughout the whole of the Glomerulosa. Under high magnification, the crystals can be seen to be contained both within the cytoplasm of the glomerular cells and in the lumen of the glomerular capillaries.

(ii) The next zone that can be observed on progressing centripetally through the cortex is a relatively narrow and optically inactive area which lies between the Zona Glomerulosa and the Outer Fasciculata. In all of the glands examined the cells of this zone were found to be completely devoid of birefringent material consistently, and close inspection demonstrated that this optically inactive zone corresponded directly to the sudanophobic zone of the adrenal cortex of the rat (Reiss *et al.*, 1936) and to the Zona Intermedia stated by Nicander (1952) to be located between the Glomerulosa and Fasciculata in the adrenals of domestic animals. The presence of this zone is demonstrated adequately in Fig. II, where it appears as a dark band between the dust-like particles of the Zona Glomerulosa and the large irregular crystals of the Fasciculata.

(iii) The main optically active zone of the adrenal cortex of Sheep consists of all, or most of, the Zona Fasciculata. Whilst the optically inactive Zona Intermedia corresponds to Bennet's (1940) " pre-secretory " zone in the cortex of Cat, this region is for the most part equivalent to that worker's " secretory " zone in the same animal. The demarcation of the outer Fasciculata from the Zona Intermedia is shown well in Figures I and II and it can be seen from these and Fig. III that birefringence in the Zona Fasciculata as a whole is characterised by the presence of large unevenly shaped crystals which are scattered throughout the whole of the parenchyma. In addition to these large highly birefringent globules, the cells (and occasionally the capillaries) can be seen to be packed with the same kind of small, intra-cytoplasmic particles of birefringent material as was noted within the Zona Glomerulosa.

(iv) The density and the relative size of the large crystals in the Zona Fasciculata are of importance when one considers the distribution of birefringent material in the fourth and final cortical zone which corresponds to the Zona Reticularis, for the change from the former zone to the latter is very gradual and, unless the cortico-medullary junction is used as a guide, the demarcation of the Reticularis is frequently hard to determine under polarised light. It can however be said that the Zona Reticularis is in general poorer in birefringent material than the preceeding zone and what crystals can be observed are larger, more irregular, more scattered and much fewer in number than those in the Zona Fasciculata (Fig. IV). Occasionally, some of the birefringent crystals in this zone are so large as to fill an entire cell but in such

XUM

cases no nucleus can be seen within the cells and thus these cells could logically be regarded as either being dead or in the last stages of senescence.

There was no evidence at all of birefringence in the medulla of any of the glands studied and this, as already remarked, rendered an acute landmark for location of the Zona Reticularis with the petrographic microscope.

Discussion

That the main area of optical activity in the adrenal of Sheep is confined to the Zona Fasciculata is in complete agreement with the findings of Weaver and Nelson (1943) in the rat adrenal, and Yoffey and Baxter (1947) in both the rat and the cat and, as the latter workers indicate that this same area is also strongly phenylhydrazine positive, it is quite logical to assume that in Sheep the Zona Fasciculata as illustrated by the presence of birefringent crystals is the most rich in definitive cholesterol of all the cortical zones.

The purpose of this paper is to record observations on the distribution of birefrigent material in the adrenal of Sheep and it is not intended to attempt a correlation between the distribution of cholesterol on the one hand and the apportion of adrenocrotical hormones on the other. However, it might be remarked that in the face of the above evidence it appears to be illogical to presume that if a relationship between cholesterol and adrenocortical hormones does exist (and study of the literature certainly seems to suggest that it does) the majority of hormonal secretions are carried out by the Zona Fasciculata. It would be rather more tenable to suppose that the Glomerulosa also contributes to the general hormonal output of the gland but that its cholesterol is not always visible in birefringent form as it may be in solution in the high fatty content of the zone which is an outstanding feature of the adrenal cortex of Sheep (Stokoe, 1958, from a thesis in the process of being submitted for the degree of Ph.D.). Thus it is conceivable that considerable amounts of cholesterol could be masked by the presence of a high proportion of glomerular lipoid just as Okey (1944) found that though the livers of guinea-pigs fed with large amounts of cholesterol might contain greatly increased amounts of both fatty acids and total cholesterol, all efforts to determine the localisation of the cholesterol and to distinguish it from other liver lipoids by means of the petrographic microscope were unsuccessful, possibly as this worker states " because the cholesterol was in solution in the fat, and the solution was itself not birefringent ".

Whether or not the quantitative and qualitative distribution of the birefringent material in the adrenal cortex of Sheep is closely associated with (a) cholesterol and (b) the production of adrenocortical hormones as is suggested for instance in the cat by Bennet (1940), cannot be stated to be the case conclusively from the observations made in this paper. A point which does lend weight to the hypothesis being applicable to Sheep however is the close association between the small birefringent particles which were readily seen within the cytoplasm of both glomerular and fascicular cells and those within the lumen of the capillaries of these zones. The normal route by which adrenocortical hormones leave the gland is of course via the blood vessels and taking this idea a step further it could be surmised that such intra-cytoplasmic particles of birefrigent material are precursors or perhaps even portions of cortical hormone which have already been discharged into these vessels. This is of course purely supposition

XUM

and no evidence that the birefringent material as a whole in the cortex of the adrenal of Sheep is linked with cortical hormones other than this relationship between the birefringent particles within the glomerular and fascicular cytoplasm and those particles noted as mentioned in the capillaries of the two zones. Nevertheless, the idea does find some measure of support in Bennet's (1940) observation that crystals of desoxycorticosterone acetate are birefringent when examined with polarised light.

The possibility that the birefringent properties of cholesterol can be hidden when the substance is in solution as Okey (1944) mentioned in connection with his work on the livers of guinea-pigs could be applied to such cholesterol as may be present in the Zona Glomerulosa of Sheep. It appears to be quite possible that cholesterol can also be present without being in fatty solution and without showing any optical activity for Leulier and Rivol (1930) have recorded the total cholesterol content of the adrenal cortex of Sheep as being between 2.12 to 4.06 per cent and of the medulla of the same animal as 3.45 to 6.60 per cent. This high medullary cholesterol content of Sheep adrenal is extremely interesting from two points of view, the first regarding the non-formation of birefringent crystals within medullary parenchyma and the second, the pronounced sudanophobia of this same region. Thus, if it can be assumed that cholesterol is present in the medulla of Sheep adrenal and nothing has been uncovered in the literature or during this work to contradict the findings of Leulier and Revol, it would lend weight to the argument that cholesterol when present in a tissue need not always possess birefringent properties. At the same time however it would tend to show, as suggested by the writer, even if a high proportion of lipoid can mask such birefringence, as cholesterol in the same region may possess, that because of the lack of medullary lipid there must logically be another form of cholesterol which is normally optically inactive.

On the other hand, in face of this argument it seems just as apt to suppose that the birefringent crystals in the adrenal cortex are not formed by cholesterol itself but possibly by the breakdown of some optically inactive precursor which occurs in fresh adrenal tissue. Yoffey and Baxter (1947) agree with this suggestion and state that in view of the fact that lipoproteins form approximately one-fourth of the blood plasma proteins as proved by Cohn (1946), the possibility exists that such an optically inactive precursor might be a lipoprotein and thus corticoadrenal hormones as a whole might enter the blood as lipoproteins. To prove such a hypothesis would necessarily require a high proportion of critical investigation of adrenal glands in all stages of physiological activity but, considering the problem dispassionately, it is not without the bounds of possibility that the actual form in which adrenocortical hormones are formed and are discharged from the gland may be uncovered at some early date.

Summary

The adrenal glands from twelve half-bred Sheep have been treated for the presence of birefringent material. The following observations have been made:

1. Optical activity in the adrenal of Sheep is invariably confined to the cortex.
2. Variations in optical activity in the cortex as manifested by the formation of birefringent crystals allow the region to be divided into four distinct zones:

(i) A subcapsular zone corresponding to the Zona Glomerulosa. Birefringence is revealed in this zone by a fine scattering of dust-like particles both

XUM

PLATE 1

FIG. 1

Frozen section of Sheep adrenal (formol fixed) photographed in polarised light within 30 mins. of mounting in syrup of laevulose. X 100.

Note the fine birefringent crystals in the Zona Glomerulosa and the optically inactive band which separates it from the distinct luminescence of the spongiocyte zone.

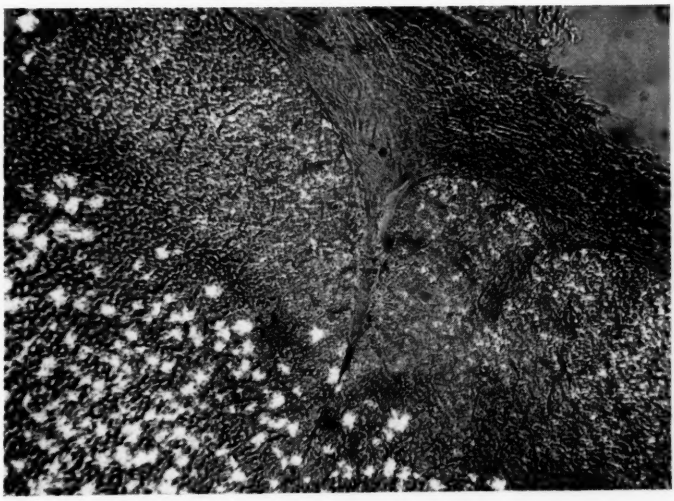


FIG. II

Frozen section of formol fixed Sheep adrenal mounted in syrup of laevulose and photographed in polarised light. X 100.

Note the zonal arrangement of crystals in the Glomerulosa and Fasiculata, and separating them the distinct optically inactive Zona Intermedia.

(Article by W. M. Stokoe on pages 463-469)

PLATE 2

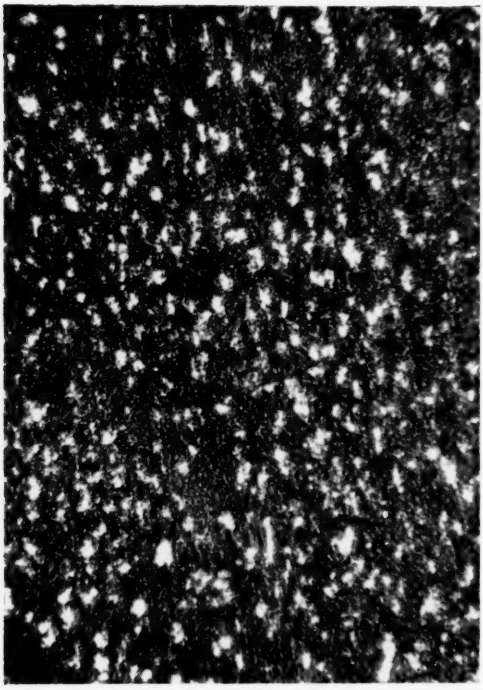


FIG. III

Frozen section through the Zona Fasiculata of Sheep adrenal after formol fixation. X 100.

Course birefringent crystals which are characteristic of this zone are very prominent against background of faint dust-like particles.

FIG. IV

Section of Sheep adrenal fixed in formol-saline, sectioned at 25mu on a freezing microtome and mounted in Zwemer's Glychrogel. X 100.

The pronounced irregular luminescence of the Zona Reticularis is in contrast to the optically inactive medulla.

(Article by W. M. Stokoe on pages 463-469)

XUM

within the cytoplasm of the cells and in the zonal capillaries.

(ii) An optically inactive zone corresponding to the Zona Intermedia.

(iii) A wide optically active zone corresponding to the Zona Fasiculata. Birefringent crystals in this zone take the form of large, unevenly-shaped globules with uniform distribution throughout the zone, and also the same type of small, intra-cytoplasmic particles as were seen in the outermost zone.

(iv) An innermost zone corresponding to the Zona Reticularis which contains very large, very irregular birefringent crystals which have a sparse distribution throughout the zone.

Acknowledgments

The writer's thanks are due to Mr. T. Grahame, T.D., F.R.C.V.S., F.R.S.E., Head of the Department of Veterinary Anatomy, University of Edinburgh, for his valuable suggestions in the preparation of this paper, and to Mr. R. Hood, F.I.B.P., F.I.S.T., who produced the photographs.

REFERENCES.

Albert, S. and Leblond, C. P. (1946): The distribution of the Feulgen and 2,4-dinitrophenylhydrazine reactions in normal, castrated, adrenalectomised and hormonally treated rats. *Endocrinology, 39,* 386.

Albrecht, A. and Weltmann, O. (1911): Uber das Lipoid der Nebennierenrinde. Wien. klin-Wschr. *24,* 483.

Bennet, H. SR. (1940): The life history and secretion of the cells of the adrenal cortex of the cat. *Amer. J. Anat., 67,* 151.

Cain, A. J. (1950): The histochemistry of lipoids in animals. *Biol. Rev., 25,* 73.

Cohn, E. J. (1946): Blood. A brief survey of its chemical components and of their natural functions and clinical uses. *Blood, 1,* 3.

Kaiserling, C. and Orgler, A. (1902): Uber das Auftreten von Myelin in Zellen und seine Beziehung zur Fettmetamorphose. *Virch. Arch., 167,* 296.

Landau, M. and McNee, J. W. (1914): Zur Physiologie des surrenales: detection histochimique et dosages chimiques. *Bull. Histol. Tech. micr., 7,* 241.

Nicander, L. (1952): Histological and histochemical studies on the adrenal cortex of domestic and laboratory animals. *Acta anat., Suppl.* 16 to Vol. 14.

Okey, R. (1944): Cholesterol injury in the guinea-pig.

Pearse, A. G. E. (1933): Histochemistry—theoretical and applied. London: J. & A. Churchill, Ltd.

Reiss, M., Balint, J., Oestreicher, F. and Aronson, V. (1936): Morphogenetic action and biological standardization of corticotropic substance from anterior lobe. *Endokrinologie, 18,* 1.

Sayers, G. and Sayers, M. A. (1948): The pituitary-adrenal system. *Recent Progr. Hormone Res., 2,* 81.

Weaver, H. M. and Nelson, W. O. (1943): Changes in the birefrigent material in the adrenal cortex of the rat following administration of adrenotrophic hormone. *Anat. Rec., 85,* 51.

Windhaus, A. (1910): Uber die quantitative Bestimmung des Cholesterins und der Cholesterinester in einigen normalen und pathologischen Nieren. *Hoppe-Seyl. Z. 65,* 110.

Yoffey, J. M. and Baxter, J. S. (1947): The formation of birefrigent crystals in the suprarenal cortex. *J. Anat., 81,* 335.

————, (1949): Histochemical changes in the suprarenal gland of the adult male rat. *J. Anat., 83,* 89.

Zwemer, R. L. (1933): A method for studying adrenal and other lipoids by a modified gelatine embedding and mounting technique. *Anat. Rec., 57,* 41.

XUM

THE CONTROL OF NEMATODIRUS INFESTATION BY PREVENTIVE TREATMENT

by

W. J. M. BLACK, B.Sc (Agric.) & R. J. THOMAS, Ph.D., M.Sc., B.V.Sc., M.R.C.V.S. and J. GREASLEY, B.V.Sc., M.R.C.V.S.

Newcastle-upon-Tyne.

Introduction

Nematodirus disease in sheep first attracted serious attention in Britain in the period 1945-50, and a number of writers have since reported on their studies of this condition, (Kingsbury, 1953; Stamp *et al.*, 1955; Thomas and Stevens, 1956; and Baxter, 1957). Unlike the typical form of parasitic gastro-enteritis this disease is of a very acute nature, loss of condition and a proportion of deaths occurring very rapidly, and usually it is too late to apply any curative measures before the lamb flock has suffered a serious check. The parasites responsible for this condition, belonging to the genus *Nematodirus*, show a high degree of resistance to the anthelmintics in common use, and reports on the curative value of these drugs show mainly negative results (Kingsbury, 1953; Turner and Colglazier, 1954; Thomas and Stevens, 1956).

In view of the difficulties involved in treating the disease it was decided to investigate the possibilities of preventing a build-up of the *Nematodirus* burden by regular anthelmintic treatment over the known danger period. This is feasible because of the short season during which the condition occurs, and the relatively constant timing of this period from year to year, (Thomas and Stevens, 1956).

As the drugs in general use appeared to be ineffective, the present study was carried out using as one treatment a complex preparation, containing copper acid arsenate, copper sulphate, nicotine sulphate and carbon tetrachloride along with other ingredients (Complex 414).*

The second treatment was an acidic piperazine phosphate.† The former preparation had not been used previously as a sheep anthelmintic, and though there are a few reports on the use of piperazine in sheep, little is known of its value in treating *Nematodirus*. Marguardt and Fritts (1956), found piperazine hexahydrate and glycopiparsol ineffective against both *Nematodirus* and *Trichostrongyles*. The work of Shumard and Eveleth (1957) suggested that piperazine citrate was effective against *Nematodirus* and other species when given in the drinking water for 24-48 hours, but they found no response from drenching with the same total dose.

Material and Methods

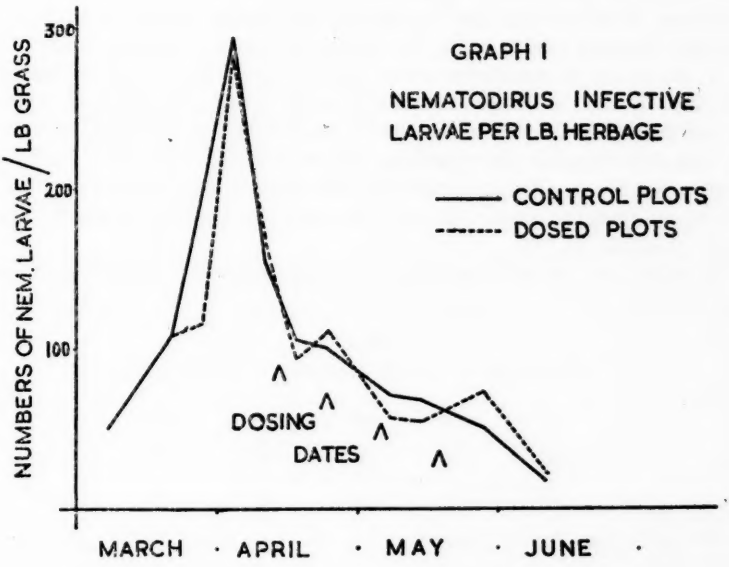
The trial was carried out in the spring of 1957, at Cockle Park, the experimental farm of the Department of Agriculture, King's College, Newcastle-upon-Tyne, with the co-operation of the Veterinary Investigation Centre, Newcastle-upon-Tyne. Eight plots, each of one acre, were available on land which had carried ewes and lambs each spring for three years in a grazing trial and which was known to be heavily contaminated with *Nematodirus* eggs. The pasture was a mature general purpose

† Coopane. Produced by Cooper McDougall & Robertson Ltd.
* Bayer 414. Produced by Bayer Products Ltd.

ley, dominantly ryegrass, but with appreciable amounts of cocksfoot and white clover. The paddocks were divided into two groups of four, selected on the basis of previous sampling history, to give uniform contamination between the groups (see Graph 1) in the following way:

4 paddocks — Control — Set-stocked ewes and lambs,

4 paddocks — Stocking as above but lambs dosed with anthelmintics.



Each one-acre paddock was stocked on April 5th with 4 comparable Grey-face ewes, each with twin lambs sired by a Suffolk ram. The lambs were approximately 2 weeks old when they were allocated at random to the plots. They remained on the plots until the trial was discontinued on July 5th. There were 32 control lambs which received no treatment and in consequence they were expected to accumulate a considerable *Nematodirus* burden. In the second group the pairs of twin lambs on each paddock were treated so that one twin received the piperazine salt and the other ' Complex 414 '. There were 16 comparable lambs on each of these treatments.

Dosing began on April 15th, when the numbers of larvae found on the pasture had risen to their peak (see Graph 1) and was repeated at 11-14 day intervals. The lambs received orally, according to treatment, either 1 oz. of the piperazine salt preparation or 5 ml. of ' Complex 414 '. Individual faeces samples were taken from the dosed lambs on the day of dosing, and from both dosed and control lambs about the third day following, with further sampling as on Graph 2. Egg counting was carried out by McMaster technique. Lamb weights were taken at fortnightly intervals throughout the trial.

Results

It can be seen from Fig. 1 that the numbers of infective larvae per pound of herbage were approximately the same for both treatments throughout the period of the trial so that it may be assumed that the control lambs were exposed to the same degree of infestation as those treated with the anthelmintics.

The results of the faeces sampling shown in Graph 2 are expressed as the mean egg counts for each dosed group and for the controls.

N. battus has been found to predominate in the North East of England (Thomas and Stevens, 1956), but this may not be the case further South, for Crofton (1955, 1957) and Spedding (1958) report *N. filicollis* as the only common species. In our trial, *N. battus* and *N. filicollis* were both present, but *N. battus* was the predominant species and was also the species most affected by the drugs. The numbers of *N. battus* eggs were greatly reduced by drenching, with peak figures of 328 e.p.g. for ' Complex 414 ', and 218 e.p.g. for the piperazine salt as compared with 1063 e.p.g. for the controls. (See Fig. 3). No great depression was found in the egg count for *N. filicollis*, and it would therefore appear that the drugs are less effective in dealing with this species. (See Fig. 4).

The distribution of peak egg counts for *N. battus* and *N. filicollis* combined are shown in Table 1:

TABLE 1

Distribution of Lambs according to Egg Counts

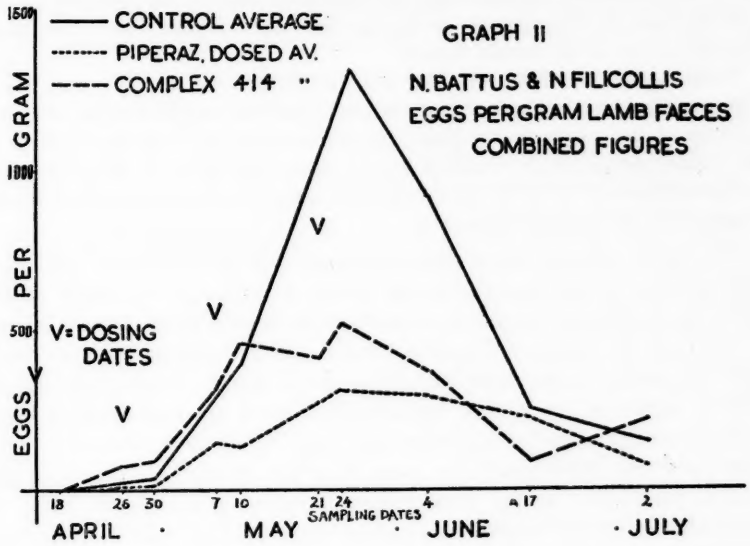
e.p.g.	>3000	3000 to 2000	2000 to 1500	1500 to 1000	1000 to 500	<500	*Total lambs*
Control	1	6	6	12	2	5	32
' Complex 414 '	0	0	2	6	2	6	16
Piperazine Salt	0	0	1	2	4	9	16

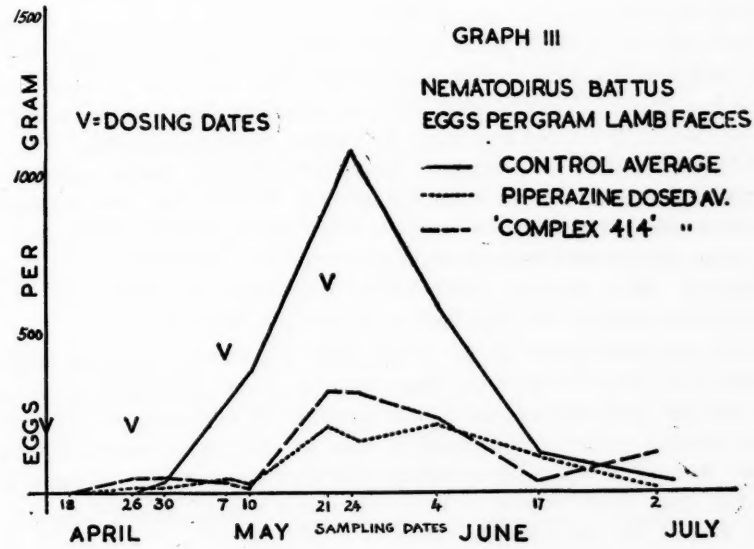
Egg counts other than those for *Nematodirus* or *Strongyloides* have been grouped together as ' trichostrongyle ' eggs and the mean counts are shown in Fig. 5.

It was found that the weight differences between groups were small, though there was a consistent advantage in favour of both the dosed groups throughout the trial. This difference however was not statistically significant.

Discussion

Both drugs appear to have exerted some measure of control over the build-up of the Nematodirus burden as reflected by the egg output, the piperazine compound exhibiting a more marked effect than Complex 414, i.e. peaks of 311 e.p.g. and 518 e.p.g. respectively, compared with the 1305 e.p.g. of the controls (see Graph 2). The fact that dosing caused a levelling out rather than a spectacular drop in egg count may be due to the large numbers of worms reaching maturity during the period up to May 14th, the drugs possibly affecting only those which had already reached maturity. It appears that these drugs do not affect the immature stages of the parasite and Kates and Turner (1953) suggest that these stages cause the pathogenic effects of infestation.


GRAPH II
CONTROL AVERAGE
PIPERAZ. DOSED AV.
COMPLEX 414 "
N. BATTUS & N FILICOLLIS
EGGS PER GRAM LAMB FAECES
COMBINED FIGURES
EGGS PER GRAM
1500
1000
500
V=DOSING DATES
V
V
V
V
18 26 30 7 10 21 24 4 17 2
SAMPLING DATES
APRIL
MAY
JUNE
JULY


GRAPH III
NEMATODIRUS BATTUS
EGGS PER GRAM LAMB FAECES
CONTROL AVERAGE
PIPERAZINE DOSED AV.
'COMPLEX 414' "
V=DOSING DATES
EGGS PER GRAM
1500
1000
500
V
V
V
18 26 30 7 10 21 24 4 17 2
SAMPLING DATES
APRIL
MAY
JUNE
JULY

XUM

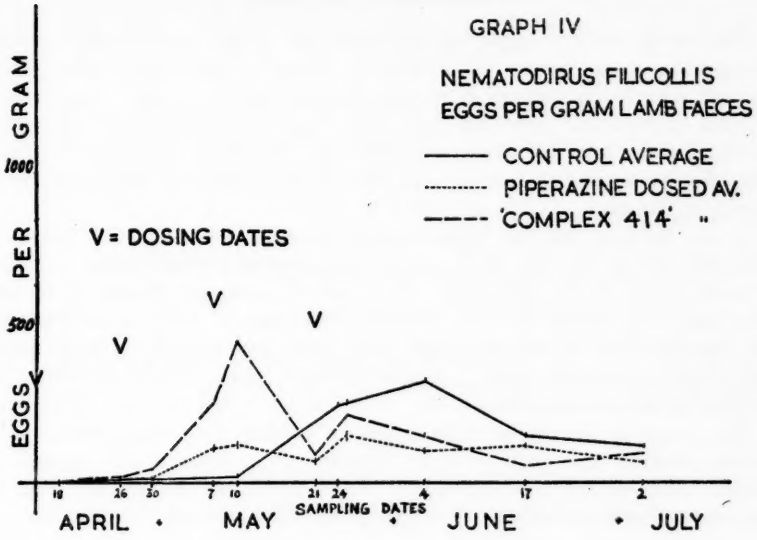
It is not possible to decide from this experiment whether the effect of the drugs was to eliminate the worm burden or whether the value was merely one of suppression of the egg output of the female worms.

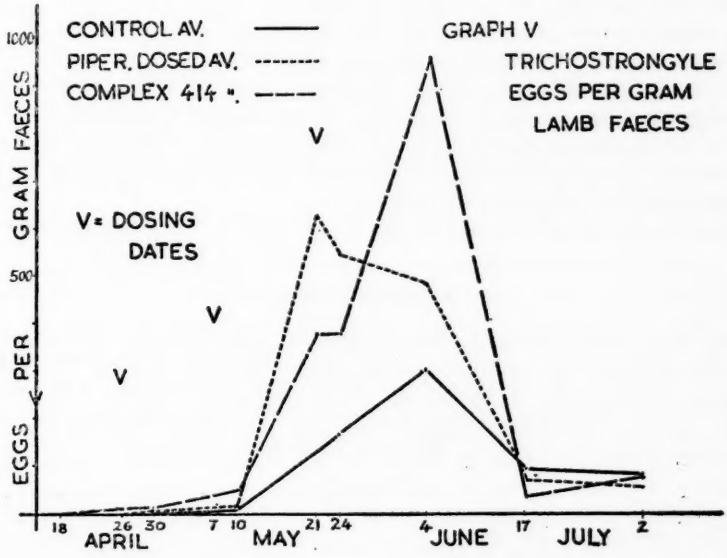
Following the last dosing on May 21st, no further rise in egg counts occurred in the treated groups, but by this time the counts had also declined in the control, and the continued low counts in the dosed groups may therefore have been due to some factor other than the drugs. Further work is being undertaken to determine whether an actual elimination of worms occurs following dosing or whether the effect is merely the suppression of egg production.

The results indicate that dosing, particularly with the piperazine salt, exerts a useful influence on the Nematodirus egg output of lambs. It is difficult to decide whether this would have affected the possibility of a disease outbreak, or have influenced the severity of an outbreak. The main value of this treatment is that it reduced the amount of pasture contamination laid down by the lambs. As the chief source of trouble in regard to *Nematodirus* infestation lies in the progressive annual build-up of pasture contamination by successive lamb crops (Thomas and Stevens, 1956), it would appear that treatment of this nature might prevent such an increase, so that it would be possible to use the same pasture for lambs in consecutive years. This would be of considerable help to those farmers whose available grazing, for one reason or another, is too limited to allow for the annual rotation of fields for the lambs, as has been recommended by Thomas and Stevens (1956). Dosing to be effective must coincide with the time that large numbers of larvae are beginning to become established with the host lamb. The accurate detection of this time on the farm could not be a practical proposition, but the desired effect could be achieved by dosing at fortnightly intervals over the presumed period in which infestation is likely to occur in the area. This period is reasonably constant and extends from mid-April to early June in North-East England (Thomas, 1958), but it is apparently slightly earlier in Northern Ireland (Baxter, 1957), and even sooner in Southern England (Spedding, 1958). This would entail dosing on 3 or 4 occasions, but on farms where this disease is troublesome, the results may justify the time and labour involved. It is felt that, where management control is not possible, preventive dosing is the correct approach to this problem and if a more efficient drug becomes available, control on a field scale would be more satisfactory. It is hoped to obtain further information by assessing the residual *Nematodirus* burden on the plots used in the trial reported here.

The egg count pattern in the control group is extremely interesting in that at no time were clinical signs of the disease or even marked scouring observed despite the high egg counts reached, i.e. a mean maximum of 1305 e.p.g. and 78% of the lambs reaching a count of 1000 e.p.g. or more, and 25% being over the 2000 e.p.g. mark. Bywater (1957) considered that an infestation associated with an egg count of 200-500 e.p.g. causes scouring in lambs and that a level of 800-1200 e.p.g. in the early part of the year generally represents a fatal infestation. The results of the present work do not support these conclusions, and it would appear that considerable caution must be exercised in predicting clinical symptoms on the basis of egg counts.

XUM


GRAPH IV
NEMATODIRUS FILICOLLIS
EGGS PER GRAM LAMB FAECES
CONTROL AVERAGE
PIPERAZINE DOSED AV.
'COMPLEX 414' "
V= DOSING DATES
EGGS PER GRAM
1000
500
V
V
V
18 26 30 7 10 21 24 4 17 2
APRIL MAY SAMPLING DATES JUNE JULY


CONTROL AV.
PIPER. DOSED AV.
COMPLEX 414 ".
GRAPH V
TRICHOSTRONGYLE
EGGS PER GRAM
LAMB FAECES
V= DOSING
DATES
EGGS PER GRAM FAECES
1000
500
V
V
V
18 26 30 7 10 21 24 4 17 2
APRIL MAY JUNE JULY

XUM

Trichostrongyle egg counts

The average trichostrongyle egg counts for the groups are interesting; previous work by Thomas and Stevens (1956) indicated that the predominant species found in association with *Nematodirus* in North-East England was *Ostertagia.* Gordon (1955, 1957) has reported that piperazine compounds were of limited value in dealing with most of the gastro-intestinal nematodes, while ' Complex 414 ' would not be expected to be effective against *Ostertagia,* and thus little control of trichostrongyles was expected in this trial.

It can be seen that the trichostrongyle output of the two dosed groups was considerably greater than that of the control and therefore it would appear that dosing has resulted either in the maintenance of a larger trichostrongyle burden in the lambs or in a higher egg output from the non-susceptible species. Other workers (Imperial Agric. Bureau, 1943; Gordon, 1953; and Betts, 1954) have suggested that the removal of the competing parasites make it possible for those which survive to maintain their infestation at an increased level.

The results of the present work appear to confirm these observations, but the processes involved are far from being satisfactorily understood. It appears that treatment with specific anti-Nematodirus drugs could usefully be combined with phenothiazine dosing in order to control gastro-intestinal parasites.

Summary

1. The use of ' Complex 414 ', and the acidic phosphate of piperazine in a preventive trial for the control of *Nematodirus* infestation is described. Both drugs and especially piperazine were found to be effective in reducing the faecal egg count of the lambs, but there is the possibility that the egg production of the female worms was merely depressed without involving their expulsion.

2. It is suggested that a dosing programme might be of value on the badly affected farms where control of the parasite by management is impracticable. It is possible that dosing for *Nematodirus* with these drugs may result in an increase in the other gastro-intestinal parasites, and it may therefore be necessary to take the usual measures applicable when these are present.

More detailed results obtained during this trial will be made available at a later date.

Acknowledgments

We thank Messrs. Bayer Products Limited, and Messrs. Cooper, McDougall and Robertson Limited, for providing the chemicals. We are indebted to Professor M. McG. Cooper, Dean of Agriculture, King's College, University of Durham, to Mr. D. Buntain, Veterinary Investigation Officer, Newcastle-upon-Tyne, for helpful advice and criticism and to C. L. Davidson for technical assistance.

REFERENCES

Baxter, J. T (1957). *Vet. Rec., 69,* 1007.
Betts, A. O. (1954). Ibid., *66,* 749.
Bywater, H. E. (1957). *Brit. vet J., 113,* 450.
Crofton, H. D. (1955). *Parasitol., 45,* 99-115.
Crofton, H. D. (1957). Ibid., *47,* 304-318.
Gordon, H. McL. (1953). *Aust. vet. J., 29,* 12, 337.

XUM

Gordon, H. McL. (1955). Ibid., *31*, 52.
Gordon H. McL. (1957). Ibid. *33*, 1.
Imperial Agricultural Bureau (1943). Joint Publication No. 4.
Kates, K. C. & Turner, J. M. (1953). *Amer. J. vet. Res., 14*, 72.
Kingsbury, P. A. (1953). *Vet. Rec., 65*, 167.
Marguardt, W. C. and Fritts, D. M. (1956). *J. Amer. vet. Med. Ass.,, 129*, 153.
Shumard, R. F. and Eveleth, D. F. (1957). *Vet. Med., 52*, 225.
Spedding, C. R. W. (1958). *J. Min. Agric.*, 64, 10, 480.
Stamp, J. T., Dunn, A. M. & Watt, J. A. A. (1955). *Scot. Agric. 34*, 213.
Thomas, R. J. & Stevens, A. J., (1956). *Vet. Rec., 68*, 471.
Thomas, R. J., (1958). Duke's Fund Report, King's College, Newcastle-on-Tyne.
Turner, J. H. & Colglazier, B. A. (1954). *Amer. J. vet. Res., 15*, 564.

PULMONARY TUBERCULOSIS IN A COW DUE TO THE AVIAN TYPE OF TUBERCLE BACILLUS

by

J. K. L. PEARSON, Ph.D., B.Sc., M.R.C.V.S.

Veterinary Research Division, The Farm, Stormont, Belfast.

and

D. McGOWAN, M.R.C.V.S.

Ministry of Agriculture, Parliament Buildings, Stormont, Belfast.

Avian tubercle infections are probably much more common in cattle than is generally realised. Francis (1958) refers to a survey by Plum (1952) in which tubercle infections from 1524 naturally infected cattle were typed. 21 per cent. were avian, 78.4 per cent. bovine and 0.5 per cent. human. Other text books (Hagan and Bruner, 1957, and Wilson and Miles, 1957) refer to the localised nature of the lesions in cattle affected by avian tubercle infections, generalised lesions being rare.

Since 1938, however, no fewer than 11 workers have recorded cases of active or open avian tuberculosis in cattle, in each instance gross macroscopic lesions being present in specific organs.

Timoney (1939) Ottonsen (1944) and Stuart and Marshall (1952) describe cases in the bovine udder. Thordal-Christensen (1952) records a case in a cow in which the udder, uterus and lungs were affected, and Tweed (1958) describes a case in the udder of a cow in which other organs were found to be involved when she was slaughtered. Burgisser and Schneider (1957) and Plum (1938) described active infections in the cow's uterus, and associated with abortion while Fincher *et al* (1954) give an account of a Guernsey cow with uterine infection combined with infection of the central nervous system. The cow had a persistent vaginal discharge and was paralysed.

Generalised lesions due to avian tubercle infection are also described in cattle by van der Hoeden (1941), Schulze (1957) and Post and Van Ulsen (1954) the two cases of Post and Van Ulsen being pulmonary in type and occurring in attested herds.

The pulmonary case the subject of this note occurred in an attested herd and at first it was treated as some other pneumonic infection. By coincidence the annual

XUM

tuberculin test of the herd was being carried out at the time of the cows illness and one of us (D. McG.) took a sputum sample for examination.

This led to the diagnosis of an acid-fast infection and to the ultimate finding of avian-type tuberculosis in an advanced form in the lungs.

Subject and History

A Fresian cow 8-9 years old in late lactation, and giving 4 gallons daily. The herd was completely self-contained and the cow home-bred. There was no history of previous illness and the beast was in excellent condition until 12th October, 1957. Then the cow was reported to be coughing badly, and on the following day she was very much worse. The cow had stopped feeding, the milk yield had dropped to almost nil and the animal had begun to lose condition.

14.10.57: Cow first seen by veterinary practitioner. Third day of clinical illness. Temperature 104.2°F. Coat dry and cow in very poor condition. Respiration accelerated and laboured and a deep cough. No consolidation observed. Treated with sulphadimidine and streptomycin for three days with no effect.

15.10.57: First day of annual herd tuberculin test and fourth day of illness. Cow regarded as typical case of pulmonary tuberculosis by type of cough, emaciated condition, dry coat and general appearance. Sputum taken for examination and found to contain very large numbers of beaded and well stained acid-fast bacilli.

16.10.57-8.11.57: While biological and cultural tests were being carried out on sputum, skin tests were completed with mammalian tuberculin and found to be negative. Cow became progressively worse. Some consolidation recognised on right side of chest accompanied by bronchitis. Sputum still positive on 24th October when the animal was taken under the Bovine Tuberculosis Order and slaughtered.

Post-mortem Examination

Carcase emaciated. Lesions confined to the right lung and an acute to sub-acute broncho-pneumonia found to involve about 30 per cent. of its volume. When sectioned, the affected lung showed acute congestion and patchy consolidation, and all bronchi in the area showed an acute purulent bronchitis. Numerous yellow foci were present throughout the affected lung tissue but there was no evidence of caseation. Local bronchial and mediastinal lymph nodes appeared to be normal.

The left lung was normal and no tuberculous changes were observed in any other organ.

Histology. " Lesions were widespread throughout the affected lung and characteristic of an active tuberculous granuloma. The lesions had necrotic centres with highly cellular reaction around, including giant cells. There was little fibrous reaction around the lesions. The amount of exudate in alveoli in affected areas varied and numerous acid fast bacilli were found in the exudate and in the lesions themselves ".

Biological and Cultural Tests. Two guinea pigs had been inoculated intramuscularly with untreated sputum, but they showed only local lymph gland reaction and

negative skin reaction to mammalian tuberculin. Two further guinea pigs, two chickens and two rabbits were inoculated with lung material and each pair were tuberculin tested and killed at 4 and 6 weeks respectively. Avian tuberculin reactions were characteristic in the chicken wattle, but in the rabbits mammalian P.P.D. tuberculin produced a pronounced response, while avian tuberculin reactions were mild. Some mammalian reaction was seen in the second guinea pigs, but the infection did not spread beyond the lumbar lymph nodes.

The chicken and rabbit killed at 6 weeks showed advanced lesions of tuberculosis.

Culture. Lung from the cow was oxalated and cultured and a very good growth obtained on Lowenstein-Jensen's medium from the 10th and 11th days. Growth on glycerin medium was better but not significantly better than on non-glycerin medium. Ultimately a typical avian-type growth developed and cultures were further used for biological tests to confirm the isolation of an avian type tubercle infection.

Discussion

No pigs were kept on the farm and the only possible source of avian infection was thought to be the stock of deep litter poultry, the poultry manure being spread on the land each year. Avian tuberculin tests were applied to the 70-80 laying hens present on the farm in June, 1958, but all tests were negative.

Before the poultry tests, the 25 adult cattle on the farm had been tested with avian and mammalian P.P.D. tuberculins and a high percentage of avian reactors found. None reacted to mammalian tuberculin at 72 hours or on boost inoculation at the 8th day (Stormont test) but three cows showed rises of 4-8 m.m. to avian tuberculin at 72 hours, and eleven others showed avian reactions of 4-15 m.m. to the Stormont test and four cows showed 3 m.m. rises. Seven of the seventeen skin reactions were diffuse in character.

The possibility of a mild but subclinical endemic avian infection in the herd was quite strong but not confirmed. Tweed's experiences (1958) with the comparative test were somewhat similar to the present herd test but the source of his clinical case was not proven definitely. Post and Van Ulsen (1954) found only one non-specific avian reactor in the herd tested by them and Fincher *et al* (1954) found several avian reactors among cattle in contact with their uterine case. It would have been interesting to see if a greater specificity and reaction had been obtained by the Stormont technique of testing in some of these herds. Our experience here indicates that more useful information can be obtained by this test than by the comparative 72 hour test.

Summary

A 9 year old Fresian cow in an Attested, self-contained herd of 25 cattle was found to have acute clinical pulmonary tuberculosis. Sputum was grossly infected and contained beaded and well staining acid-fast bacilli.

Biological and cultural tests on the sputum and lung material confirmed the infection to be avian-type tubercle infection. Tuberculosis was confined to the left lung and was not found elsewhere in the animal. An account is given of the post mortem and histological findings.

Comparative and Stormont tuberculin tests on the herd showed that avian sensitivity was pronounced in the remaining cattle. Tests on deep litter poultry on the farm were negative.

XUM

REFERENCES

Burgisser, H. and Schneider, P. A. (1957). *Schweiz. Arch. Tierheilk., 99,* 257.
Fincher, M. G., Evans, W. M. and Saunders, L. Z. (1954). *Cornell Vet., 44,* 240.
Hagan, W. A. and Bruner, D. W. (1957). *The Infectious Diseases of Domestic Animals,* London: Bailliere, Tindall and Cox, 3rd ed., p. 320.
Hoeden, J. van der (1941). *T. Diergeneesk., 58,* 335.
Ottonsen, H. E. (1944). *Skand. vet. T., 34,* 1.
Plum, N. (1938). *Acta. path. microbiol. scand.* Suppl. *37,* 438.
Plum, N. (1952). *Nord. Vet. Med., 4,* 461.
Post, R. and Van Ulsen, F. W. (1954). *T. Diergeneesk., 79,* 579.
Schulze, J. (1957). *Mh. VetMed.,* p.216.
Stuart, P. and Marshall, P. M. (1952). *Vet. Rec., 64,* 309.
Thordal-Christensen, A. (1952). *Nord. Vet. Med., 4,* 577.
Timoney, J. F. (1939). *Vet. Rec., 51,* 191.
Tweed, W. (1958). *State Vet. J., 13,* 67.
Wilson, G. S. and Miles, A. A. (1955). Topley and Wilson's *Principles of Bacteriology and Immunity.* London: Edward Arnold, 4th ed.

STUDIES ON METABOLISM OF CREATINE AND CREATININE IN THE DOG

1. URINARY EXCRETION OF MALE ANIMALS UNDER DIFFERENT EXPERIMENTAL CONDITIONS

by

M. G. E. MOUSTAFA EL HEHYAWI*
B.V.Sc., M.V.Sc. (Cairo), Ph.Dd. (London)

Department of Biochemistry and Chemistry, Faculty of Veterinary Medicine, Cairo University, Egypt.

Creatine, though normally a constituent of the urine of fish, amphibia, reptiles and birds, is generally recognised to be a sporadic constituent of that of adult mammals. Creatine excretion has been shown by Folin (1905), Marshall (1920) and others to be constant regardless of marked changes in the volume of the urine.

Among many estimations of creatine and creatinine excretion relatively few have been concerned with canine urine. This investigation was therefore undertaken to supply more data on creatine metabolism in the dog.

Experimental

The animals used in this experiment were healthy males of different ages. They were thoroughly tamed and accustomed to being handled and caged. This is an extremely important point for even in the best trained dogs we found that during the first period of observation, on any one day, abnormal signs may be manifested, due presumably to psychic disturbance. All dogs were fed on a normal fixed diet or on an experimental low-protein diet. Water was admitted *ad libitum*.

* Now at Guy's Hospital Medical School, London.

XUM

Collection of Urine. Twenty-four hours urine specimens were collected daily using a metabolic cage. Urine was collected in sterile brown bottles and preserved with thymol. The samples were stored immediately after collection at 0°C. which permits conservation of the specimens until the moment of analysis. The conservation was controlled by comparing the pH of the urine at the time of examination with its pH measured at the end of the 24 hour collection. All samples with a change in pH were discarded. Precautions were taken to avoid urine contamination with particles of food or faeces and to ensure accurate urine collection. Appropriate aliquots of urine were assayed for creatine and creatinine according to the procedure given below.

Creatine and Creatinine Determination. The method of Bonsnes and Taussky (1945) for spectrophotometric determination of creatinine and creatine was used, and a standard curve is plotted in Fig. 1. It was found that 0.5 ml. samples of urine give suitable readings. A series of precision tests revealed this technique to introduce an error of ± 3 per cent. in the final results. Care was taken that picric acid conformed to the standards of purity established by Folin & Doisy (1917). For accurate results the curve was checked and re-established with each new lot of picric acid.

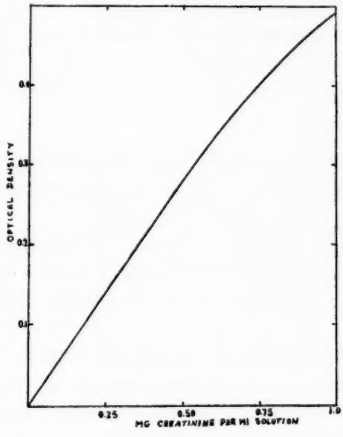


FIG. 1 Standard curve for estimation of urinary creatinine, calibrated at 520 mu in 1 ml. cell.

Results

In this study the creatine and creatinine output were measured daily for periods of 21 to 30 days. Absence of creatine from the urine was sporadic and never extended for more than one or two days in any of the cases examined. Table 1 illustrates the results obtained under different conditions.

In dogs with a protein intake changed from 7-10 g N per day to 0.7-1.0 g N per day the per cent. creatinine variation was found to be no greater than that observed at normal protein levels. It is recorded that Benedict (1915) observed a creatine variation of only 0.8 to 1.4 g per day in the 30-day fasting man which is no greater than that found in normal well-fed individuals.

A study has been made upon the creatine excretion of different age groups. Creatinuria in suckling pups is largely due to the creatine content of the milk ingested.

XUM

TABLE 1.

Creatine and Creatinine Excretion in Normal Male Dogs under Different Physiological Conditions.

Number of cases studied	*Experimental condition*	*Creatine mg. % M ± S.D.**
7	Protein intake 7-10 g/day (normal diet)	5.2 ± 0.85
9	Protein intake 0.7-1.0 g/day (experimental diet)	6.0 ± 1.0
15	Body weight 11-20 lbs.	6.6 ± 1.4
11	Body weight 25-35 lbs.	7.5 ± 2.3
7	Prematures†	almost none
8	1 - 2 weeks†	7.7 ± 0.3
7	8 - 12 weeks	16.5 ± 1.3
9	Age group 5 - 8 months	13.4 ± 2.7
12	8 - 12 months	9.3 ± 0.5
12	1 - 4 years	6.1 ± 1.1
5	6 - 8 years	5.0 ± 0.3
8	Normal diet	6.8 ± 1.7
8	Normal diet supplemented with arginine	10.3 ± 2.5
6	Normal diet supplemented with glycine	13.1 ± 0.7
7	Experimental diet supplemented with arginine	6.0 ± 1.0
5	Experimental diet supplemented with glycine	5.7 ± 1.6

* Mean ± standard deviation.

† Fed on milk diet.

It was found that creatine attained its highest excretion level between the age of 5 to 8 months and it declined with advancement of age. Except for the prematures, it was demonstrated that creatinuria occurs in all age groups investigated.

The amount of creatine excreted appeared to bear a definite relationship to the body weight. The larger breeds of dogs excrete more than the smaller ones. In some cases, it was observed that the excretion of creatinine is not necessarily dependent upon the body weight.

In one experiment, the addition of 2 to 3 gm. of the amino acid arginine to the normal diet increased the excretion of creatine and creatinine except in two cases when arginine did not affect their excretion. When glycine was added as supplement to the normal diet an increase was observed in creatine and creatinine output in all cases studied. When the same amounts of both amino acids were added to the low protein diet (experimental diet) they failed to affect the levels of excretion of creatine and creatinine.

Discussion

It has been thought that, under ordinary circumstances, human urine is free from creatine. Beard, (1943) re-investigated this point and came to the conclusion that adult humans do excrete creatine and that inaccuracy and lack of specificity of analytical procedure may in part explain the failure of previous workers to detect creatine in urine. Our results on canine urine are in accord with this evidence of Beard, and support the importance of the use of highly sensitive and accurate technique for analysis.

XUM

Since meat, milk, and cereal proteins were excluded from the low protein diet, the regimen is considered creatine poor. On the basis of the results given in Table 1 creatinuria in the adult dog cannot be considered symptomatic of starvation, hyperthyroidism, etc., unless it be in excess of the levels recorded in the Table.

It has been stated that creatinuria does not occur in breast-fed normal infants (Thomsen, 1938). This is in accord with our results and with the fact that human milk does not contain much creatine (usually 0.5 mg. per 100 ml.). The increased and consistent excretion of creatine in the urine of puppies may be attributed to an increase in creatine formation from its precursors: arginine, glycine, and methionine.

Arginine and glycine were found to augment the output of creatine in the urine of adult rats when added to the diet in adequate amounts (Beard, 1931) and in human subjects also. The two amino acids are now generally accepted as the chief precursors of creatine. It is established that the amino acids arginine and/or glycine will not form creatine if diets low in protein are ingested. The protein requirements of the tissues must be met, otherwise the ingested glycine will be utilised for the formation of tissue proteins and not of creatine.

Summary

Creatine and creatinine excretion by normal male dogs was studied under different conditions, viz. variation in protein intake, weight and age, and supplementation of the diet with the chief precursors of creatine: arginine and glycine.

REFERENCES

Beard, H. H., (1931). *Proc. Soc. exp. Biol. Med., 28,* 454.
Beard, H. H., (1943). " Creatine & Creatinine Metabolism ", 1st Ed. Chemical Publishing Co., Brooklyn, U.S.A.
Benedict, F. G. "A Study of Prolonged Fasting", Carnegie Institute, Washington, D.C. (1915).
Bonsnes, R. W. & Taussky, H. H. (1945). *J. biol. Chem., 158,* 581.
Folin, O., (1905). *Amer. J. Physiol., 13,* 65.
Folin, O. & Dennis, W., (1912). *J. biol. Chem., 11,* 253.
Folin, O. & Doisy, E. A., (1917). *J. biol. Chem., 28,* 349.
Marshall, E. K., (1920). *Pharm. exp. Therap., 16,* 141.
Rose, W. C., (1911). *J. biol. Chem., 10,* 265.
Thomsen, A., (1938). Thesis, Inst. Med. Physiol., Copenhagen.

XUM

CORRESPONDENCE

10 Red Lion Square,
London, W.C.1.

To The Editor,
British Veterinary Journal,
Messrs. Bailliere Tindall & Co.,
7/8 Henrietta Street, W.C.2.

Sir,

V.V.B.F. Christmas Appeal

With the approaching festive season, we should like to remind readers of the Christmas Gift Account from which we are enabled to give our less fortunate colleagues or their widows (some with children) a monetary gift so that they too may be able to enjoy a happy Christmas.

May we therefore ask all who read this appeal to kindly show their interest in and support of this good work by sending at an early date a donation, however small, to the Secretary, V.V.B.F., 10 Red Lion Square, London, W.C.1.

If, on the other hand, you would prefer to send a special Christmas parcel to one of the Fund's recipients, the address will be gladly supplied.

Yours faithfully,

H. W. DAWES, President.
J. McCUNN, Hon. Treasurer.
J. J. DUNLOP, Hon. Secretary.

26th November, 1958.
Victoria Veterinary Benevolent Fund.

REVIEWS

A PONY EVERY TIME, by Geoffrey Lapage. Illustrated by Ann Bullen. Burk Publishing Company Ltd., 55 Britton Street, London, E.C.1. 8/6 nett.

Another delightful story from the pen of our old friend Geoffrey Lapage. We again meet Susan and her pony Dusky who, with old friends, new friends and more ponies, spend a holiday in new country and camping by the River Sel. The ponies are, of course, the centre piece and Ann Bullen's illustrations, especially the coloured one on the jacket are most attractive.

The children have quite a lot of adventures on and about the river and on their country rides. Geoffrey Lapage appeals to the modern child but he is a children's author of the old school also for hidden in the lines there is a great fount of information on natural history and archaeology which does not hamper the theme in any way and which any child will unconsciously absorb.

It is a great pity that more of the modern children's books do not take advantage of this intriguing method of imparting knowledge.

A grand present for any child who is interested in animals and the countryside.

MYCOSES OF MAN AND ANIMALS. By R. Vanbreuseghem, translated by J. Wilkinson. London; Sir Isaac Pitman & Sons, Ltd., 1958. pp. xi + 235. 50s.

In 1950, at the time of his death, Dr. Maurice Langeron had been engaged in preparing a second edition of his *Précis de Mycologie*. His friend and former pupil Professor Vanbreuseghem became responsible for the completion of this work and,

XUM

in the new edition published in 1952, it was divided into three parts. The first, on mycology, represented the greater portion of the original book. Descriptions of technical procedures were collected together and formed the second part. The third part, devoted to medical mycology, was an entirely new contribution by Professor Vanbreuseghem and this has now been translated into English by Dr. J. Wilkinson. The book presents a study of the mycoses, in alphabetical order, within the compass of seventeen chapters. No references later than those published in 1952 are, of course, included. The amount of textual matter devoted specifically to the infections of animals is disappointingly meagre; for example, although 76 pages—almost a third of the book—are devoted to the dermatophytes there is practically no information on ringworm in animals. Because of this and because there is no introductory mycology included in the work, veterinary surgeons, and more particularly students, may not find this book very helpful. The translation has been carefully prepared, the book is well produced and contains 48 figures.

THE BLOOD STOCK BREEDERS REVIEW. Vol. XLVI 1957. The British Bloodstock Agency Ltd., 26 Charing Cross Road, London, W.C.2. Price £4 4. 0.

This handsome annual with its beautiful coat and graceful format is in itself a thoroughbred for it is a striking example of the best craftsmanship from the Publishers stable. It is a book that compels admiration and which one handles with care instinctively. This tribute to the craftsmen who make it and the Editors and Publishers who produce it is long overdue.

This volume is bigger and better than ever and, as usual, it covers every facet of the T.B. world in this country and abroad. The wealth of information which is encompassed gives it the character of an encyclopoedia of current T.B. affairs. It serves as a vade mecum for those concerned with the industry today and like all its predecessors it will be of great historical value in the years to come. The student of thoroughbred breeding and racing can turn to it time after time and always find something of interest and never be satiated.

THE MIND OF THE DOG, by R. H. Smythe, M.R.C.V.S. Country Life Ltd., 2/10 Tavistock Street, London, W.C.2.

It is not an easy matter to assess the quality, be it good or bad, of the mind of a normal human being. If the subject under examination be relatively abnormal, then the task is lightened and a trained psychologist can give some explanation for aberrations, be they to the right or left of the customary mean. One of the doubtful factors in arriving at a correct conclusion rests in the psychologist himself. Is the quality of his own mind subjected to scrutiny? By what standard is he judged and who makes the assessment of his rectitude. Are the psychologists subjected to tests to see if they are normal and capable of passing judgment on fellow creatures of the same species. Now when one sets out to examine the mind and the mental behaviour of an animal of an entirely different species the task must be harder still. Estimates must be based on objective signs for, in the absence of coherent speech and understanding thereof, subjective symptoms are at a discount.

When a man seeks to study the mind of a dog he has to depend on objective signs and that means that his powers of observation and deduction must stand at a high level. A perusal of the pages of this book indicates at once that the author is a keen observer. He has seen what many others have missed, he can marshall his observations in logical sequence and come to conclusions which are rational according to the evidence displayed. He points out that one must not judge dogs by human standards as is done so often by the sentimentalists. He will shock many by alleging that dogs are not capable of analytical thought and that their actions depend on past experiences and memory.

The author discusses the various factors which govern behaviour, intelligence, temperament, memory, etc. and the influence of the special senses, sight, hearing, the

XUM

sense of smell and taste. The part of the book which is devoted to the manifestation of emotion and the chapter on social behaviour are intriguing and well worth study. One would expect R. H. Smythe to stray from pure orthodox conceptions and give us something unique and with food for thought and cogitation. His book is unique, it contains much food and veterinary surgeons will read it with interest and delight and appreciate his deep sense of humour and his stories of the dogs he has known.

NEOMYCIN, ITS NATURE AND PRACTICAL APPLICATION. Edited by S. A. Waksman (1958). London: Bailliere, Tindall & Cox Ltd. pp. x + 412. Price 40s.

This volume is edited by Selman A. Waksman, with Hubert A. Lechevalier and Burton A. Waisbren as associate editors, and Robert A. Day as assistant editor. It is published for the Institute of Microbiology, Rutgers University, New Brunswick, U.S.A. To quote from the preface 'An attempt has been made to present in this volume a comprehensive summary of the nature and utilisation of neomycin, accompanied by as complete a bibliography of the literature pertaining to neomycin as could be assembled'. It contains contributions from 35 authors all working in the United States of America, and gives 691 references in the bibliography, with many additional supplementary references at the end of each chapter. There are 30 chapters and 2 appendices.

Following an historical introduction the book is divided into 4 sections dealing respectively with Microbiological and Chemical Aspects, Antibacterial and Pharmacological Properties, Clinical Uses, and Miscellaneous Uses.

In the last section there are two chapters of direct interest to the veterinarian. Chapter 28 by W. N. Konde of the Royal Oak Veterinary Hospital, Royal Oak, Michigan, deals with Neomycin in Veterinary Medicine and Chapter 29 by Kennett B. Hass of the Veterinary Medical Department of the Upjohn Company is concerned with Neomycin in Animal Nutrition.

The antibiotic neomycin was first reported by Waksman and Lechevalier in 1949. Since then intensive studies have been made to determine its properties and possible uses. There are few reports of its use in veterinary medicine until 1952. Neomycin is of greatest value in the treatment of enteritis. It is also useful in combination with other agents for the treatment of mastitis in cattle. Topical application to the skin, conjunctival sac and external ear is also of value. The parenteral use of neomycin in veterinary medicine has still to be evaluated.

This handsomely produced book is a most useful summary of the published work on neomycin.

J. S.

NOTICES

BURROUGHS WELLCOME & CO. announce the introduction of 'Ovigest' brand Elixir for treatment of the weakly lamb. 'Ovigest' may be given by mouth or by injection and is available from December 17 in unit packs of 12 x 25 c.c. bottles.

The Distillers Company (Biochemicals) Limited announces that the following veterinary products are no longer available:—

'Distule' PP 100 — Cartons of 10 & 100
'Distule' PP 300 — Cartons of 10
'Distule' PS — Cartons of 10

GLAXO LABORATORIES LTD. announce price reductions for Veterinary Intradex as from 1st December, 1958. These reductions apply to both the 125 ml. bottle and the 540 ml. bottle.

XUM